THE HERBARIUM BUILDING.

MISSOURI

BOTANICAL GARDEN.

FIFTH ANNUAL REPORT.

ST. LOUIS, MO.:
PUBLISHED BY THE BOARD OF TRUSTEES.
1894.

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN.

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* *Ex officio.*

[1] Elected President of the School Board November 14th, 1893, in place of Gist Blair, who had met with the Board for a year prior to that date.

[2] Elected Mayor of St. Louis April 4th, 1893, in place of Edward A. Noonan who had held that office since the organization of the Board.

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PREFACE.

Under direction of the Board of Trustees, the fifth annual report of the Missouri Botanical Garden is presented to the public. The fourth report was issued March 17th, 1893, but reprints of scientific papers from that volume, fixing the date of their publication, were issued as follows: Hitchcock, Plants of the Bahamas, Jamaica and Grand Cayman, March 9, 1893;* Trelease, Further Studies of Yuccas and their Pollination, March 9, 1893. Reprints of papers from the present volume were issued in advance of its publication, as follows: Bay, Bibliography of the Tannoids, May 18, 1893; Glatfelter, Study of the Venation of Salix, October 5, 1893; Trelease, Sugar Maples and Maples in Winter, January 1, 1894; Trelease, North American Species of Gayophytum and Boisduvalia, January 5, 1894. The last three articles have been slightly corrected before the printing of the volume.

The reports of the Garden are sent regularly to scientific institutions and journals in exchange for publications desirable for the work of the Garden, and, so far as is possible, reprints of the botanical articles which they contain are sent to botanists to whom these papers are directly useful in their work. The regular agents for the sale of Garden publications are Dr. A. E. Foote, of Philadelphia, W. Wesley & Son, of London, and R. Friedländer & Sohn, of Berlin.

WILLIAM TRELEASE.

St. Louis, Jan. 11, 1894.

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* An important correction to this article should be made on p. 171, line 10, by substituting 178 for 718.

IN THE ARBORETUM.

REPORTS FOR THE YEAR 1893.

REPORT OF THE OFFICERS OF THE BOARD.

SUBMITTED TO THE TRUSTEES JANUARY 10TH, 1894.

To the Board of Trustees of the Missouri Botanical Garden:

The financial condition of the Trust is most encouraging. The receipts for rentals for the year, while not showing the increase anticipated in the last report, owing to several vacancies which existed throughout almost the entire year, show an increase over the previous year of $3,000, owing to increased rentals in certain localities.

The properties have been kept in good repair, and in some cases extensive improvements have been made, and nearly all are tenanted.

Much of the real estate located near the Garden cannot be utilized in the manner indicated in Mr. Shaw's will, and by reason of increased taxation has become a heavy burden, in some instances a great drain, upon the revenue of the Trust, and steps should be taken towards securing additional income from it.

The Garden has been kept up in good condition, repairs made to buildings, and large additions to the collection of plants, herbarium and library, both by purchase, exchange and donation. For details you are referred to the Director's annual report.

After paying due regard to the special annual bequests in Mr. Shaw's will, paying all necessary expenses of carrying on the Trust and providing for the Garden, we are enabled to carry forward as a surplus for the year the sum of $14,649.75.

We have also added to the value of the Library, Herbarium and Garden, the following sums, which have been credited to the Stock Account, which now aggregates $1,471,696.14.

Library	$4,118 52
Herbarium	1,941 70
Garden, for furniture for Library	255 37
Total	$6,315 59

For a full and detailed account of the receipts and expenditures you are referred to the following statement: —

RECEIPTS.

Rents	$92,189 74	
Garden, pasturage and sales	769 57	
Interest, cash discount on taxes	353 66	
Garden hand-book sales	103 45	
Publications	21 35	
Loss by fire to buildings	1,289 02	94,726 79
Cash Balance January 1st, 1893		25,894 57
Total		$120,621 36

EXPENDITURES.

Garden Account —		
Labor, including garden pupils	$15,537 70	
Fuel	1,487 00	
Stable and implements	598 18	
Repairs and supplies	2,371 45	
Scholarship, care of lodge and supplies	560 11	
Plants and seeds	618 35	
Herbarium	1,418 41	
Library, books, subscriptions, etc	4,443 52	
Garden Office, salaries, supplies, etc	4,609 06	$31,643 78
Garden Improvements —		
Furnishing Library	255 37	255 37
Publication Account —		
Annual volumes	2,272 09	
Garden hand-book	892 10	3,164 19
Property Expenses —		
Commissions for collecting rents	3,035 95	
Taxes, State, school, city and sprinkling	21,346 04	
Streets, pavements and sewers	2,429 96	
Insurance	4,216 80	
Repairs	5,088 66	36,117 41
Office Account —		
Office salaries	2,500 00	
Rent of office	540 00	
Printing, postage and telephone	324 75	3,364 75
Sundry Accounts —		
Legal expenses	665 95	
Repairs to buildings damaged by fire	1,288 18	1,954 13
Bequests, Annual —		
Premiums to flower show	400 00	
Flower sermon	200 00	
Trustees' banquet	969 55	
Gardeners' banquet	318 50	
Washington University	1,583 93	3,471 98
Investment		25,000 00
Cash on hand December 31st, 1893		15,649 75
		$120,621 36

The books of the Board have been closed after showing the operations for the year ending Dec. 31, 1893, and the receipts have been disposed as follows:—

Rent account	$92,189 74
Interest	353 66
Loss by fire and repairs to same	84
	$92,544 24

CONTRA.

Garden expenses	$30,874 21	
Office expenses	3,364 75	
Commission	3,035 95	
Repairs	5,088 66	
Insurance	4,216 80	
Taxes	21,346 04	
Street pavements and sewers	2,429 96	
Legal expenses	665 95	
Washington University	1,583 93	
Flower sermon	200 00	
Trustees' banquet	969 55	
Gardeners' banquet	318 50	
Premiums at flower show	400 00	
Publications	2,250 74	
Garden improvements	255 37	
Garden hand-book	788 65	
	$77,789 06	
Surplus for 1893	14,755 18	
	$92,544 24	$92,544 24

Surplus to January 1, 1893	23,561 59
Add amount due to stock account for sales, 1892	2,332 98
Surplus for 1893	14,755 18
Total surplus December 31, 1893	$40,649 75

Respectfully submitted,

Attest,
A. D. CUNNINGHAM, *Secretary.*

R. J. LACKLAND, *President.*

AGAVE MEXICANA, BY THE MAIN GREENHOUSE.

FIFTH ANNUAL REPORT OF THE DIRECTOR.

SUBMITTED TO THE TRUSTEES JAN. 10, 1894.

To the Board of Trustees of the Missouri Botanical Garden:

The following report on the Missouri Botanical Garden and the Henry Shaw School of Botany is respectfully submitted, in compliance with the rules of the Board.

THE BOTANICAL GARDEN.

So far as we have means of ascertaining, the number of visitors to the Garden during the past year was a little greater than in 1892. On the open Sunday in June, 14,250 persons visited the grounds, notwithstanding the occurrence of frequent showers during the afternoon, and on the open Sunday in September, which was a pleasant day, 14,400 persons passed the gate. So far as could be learned, the visitors noticed and appreciated the improvements which have been made since last year.

The greater part of the western side of the grounds has this year been put in grass, as was done last year on the eastern side, and the borders, which are arranged in circles about the observatory in the center of the Garden, have been also covered with turf. Notwithstanding the large amount of cultivated ground thus converted into lawn, the number of decorative plants used for bedding has been increased, and the distribution of color through the grounds has not been restricted, for in the parts of the Garden referred to, these plants are now gathered in small natural groups, the effect of which is heightened by their setting of regularly mown grass. This change has been commented on favorably by many visitors.

Owing to the death of many of the shrubs composing the hedges of the labyrinth in the southern end of the

arboretum, and the impossibility of replacing those that had died, or of entirely renewing the hedges without removing a fine weeping ash and several well grown hemlock trees which stood in the maze, it was decided by the Board, in 1892, that the labyrinth should be taken out. In the early part of 1893, therefore, the labyrinth was removed, a portion of the ground was graded and seeded to blue grass, and the remainder was covered by a piece of natural rock work, constructed of the porous limestone of the Meramec river. Through the open season, this rockery is occupied by the large collection of cacti and agaves, forming a naturally arranged Mexican garden. A small rockery for the growth of alpines has also been formed under one of the shelter houses by the Linnean House, and a sinuous lily pond has been made about the old summer house at the extreme western part of the arboretum. The wild garden in the southern part of the arboretum has been maintained about as in the preceding year, though an effort is being made to confine the small beds in it to one, or at most a few, species each.

During the year some 1,490 packets of seed have been received by exchange or donation from other institutions, including 200 bulbs from the Cape of Good Hope, and about 2,220 packets have been distributed. Several fine plants have been obtained by purchase, notably a large specimen of Encephalartos horrida, an old Cycas revoluta, and a fine tree of Dicksonia Chamissoa, one of the ferns. Donations of specimen plants have been made to the Garden by the Michel Plant and Bulb Company, Mr. D. S. Brown, Mr. C. R. Orcutt, and Mr. Fred Kanst, of South Park, Chicago. The Garden also has the promise of a large number of plants which were used about the French building and elsewhere on the Exposition grounds in Chicago, which we expect to receive early in the spring. The plants loaned by the Garden for the Missouri exhibit in Chicago have been largely donated to the University of Missouri and the Chicago parks, by direction of the Board.

CEREUS PERUVIANUS, IN THE ROCKERY.

As was done last year, about 1,000 of the best of the plants which could be saved when the beds were cleared after the first autumn frosts, were distributed in the tenement region of the city through the interest of the managers of the Bethel.

In the summer a small, cheaply built plant house was constructed at the rear of the main greenhouse, making it possible, for the first time, to bring a considerable number of plants into bloom in the winter, so that during the present winter more color than usual is being introduced into the main greenhouse. The comfort of visitors has been increased by the introduction of water closets at the main gate, in place of the very unsatisfactory vaults previously in use there; and the nuisance occasioned by the smoke from the greenhouses has been largely removed by the employment of coke in place of soft coal for all houses except those heated by flues, where, as heretofore, wood is used because of its special adaptation to this primitive manner of heating. A considerable number of additional metallic labels have been affixed to trees in various parts of the grounds, and the labeling of herbaceous plants has been much more satisfactory than ever before, although there still remains room for improvement with these.

The average number of gardeners and laborers employed has been 40, and the labor pay-roll for the year amounts to $15,537.70. The minor improvements made during the year have been reported to the Board in detail, from month to month but they may be summarized as follows: 240 running feet of drain tile was laid; 18,000 square feet of ground has been sodded, and 224,200 square feet prepared and seeded to blue grass (including about 9,000 square feet about the lodge); 3,500 square feet of good cinder walk was made in the vegetable garden, and 6,800 square feet of less durable cinder walk in the arboretum, in addition to regraveling the greater part of the walks in the garden proper, as a consequence of a severe rain storm

in July; and a small summer house was reconstructed in the grounds at the rear of the herbarium building.

In the early part of July, the garden was visited by an unusually severe hail and rain storm, four inches of water falling in about an hour and a half, — most of it within half an hour. Though the hail entirely destroyed the foliage of the larger leaved plants, no glass was broken. The most severe damage was done to the walks, for, notwithstanding the abundant drains and silt pits of the main garden, the water collected to a depth of about three feet in the extreme northern end of the garden, where it was held by the stone and brick walls, backing up from there nearly to the gate, and completely filling the sunken parterre. The rushing of this volume of water over the walks quite denuded them of gravel, but the foundations laid some three years ago were not injured, and within a few days the walks were in nearly as good condition as before the storm, though it has been found impossible to secure as compact binding of the gravel as at first.

The droughts and extreme alternations of winter temperature each year since I have been in charge of the garden have told not only on the lawns, on which it has been necessary to expend much labor each year, but also on the woody plants, especially the evergreens. The Norway spruce, in particular, has suffered from these causes, and it will be but a few years before all of the older trees of this species have disappeared from the Garden. The old red cedars arranged along the walks of the garden proper, which for many years have been a striking feature of the Garden, are also succumbing, and it has been found necessary to remove many of them during the past two years, and also a considerable number of arbor vitaes. I observe from the last report of the Director of the Botanic Garden of Harvard University that the same loss of evergreens has been experienced there, from the same causes. While it is a matter of regret to lose any well grown tree, the garden and arboretum have been overcrowded because

LILY POND, IN THE ARBORETUM.

of too close planting in the first instance, so that except where trees have grown so as to mutually injure one another, the removal of those which die is in the main beneficial, and new trees are being planted where it is desirable to replace those which have been lost.

The additions to the herbarium during the year have consisted mainly of current American collections. A part of the specimens reported a year since as received have also been mounted and distributed. The number of sheets incorporated in the herbarium in 1893, and not previously reported, is 19,417, of which 9,304 were purchased, 3,618 were derived from the Bernhardi herbarium, not previously distributed, and 6,495 received by donation or exchange, or collected in or about the Garden. Of this latter number, 1,260 specimens were contributed by Mr. B. F. Bush, who collected largely in the more poorly explored portions of the state, adding much to our knowledge of its botany. The principal donors of the year have been the Botanical Garden of Copenhagen, Professor Miyabe, of Sapporo, Japan, Captain J. Donnell Smith, of Baltimore, Professor C. S. Sargent, of the Arnold Arboretum, Mr. C. G. Lloyd, of Cincinnati, Dr. J. Schneck, of Mt. Carmel, Illinois, the California Academy of Sciences, and Mr. J. Q. A. Fritchey, of this city. The herbarium as now arranged consists of the following collections: —

The Engelmann herbarium (all groups)		98,000 specimens.
The general herbarium of higher plants:		
The Bernhardi herbarium	61,120	
Other specimens	46,880	
	108,000	"
The collection of Thallophytes	16,420	"
Making a total of about		222,420 specimens.

In addition to these hebarium specimens proper, the Garden possesses a set of wood wedges illustrating the forestry report prepared by Professor Sargent as one of

the volumes pertaining to the census of 1880, and forming a portion of the material received some years ago with the Engelmann herbarium, and 1,719 thin veneers of woods, mounted as transparencies, and comprising 541 sections from the logs of the well-known Jesup Collection of Central Park, New York, 78 sections of the set of Hough's American Woods, and 1,100 sections, comprising the entire set thus far issued, of Professor Nördlinger's Holzquerschnitte.

During the year, 1,320 volumes and 1,344 pamphlets have been purchased, the expenditure for the year for purchases, subscriptions and binding being $3,389.47; and 284 volumes, valued at $439.20, and 983 pamphlets, valued at $169.85, have been received by donation or exchange. In the summer, the prelinnean library donated by Dr. E. Lewis Sturtevant, of South Framingham, Massachusetts,* consisting of 463 volumes, many of them containing several treatises, and accompanied by a number of volumes and pamphlets pertaining to more recent botany, was received at the Garden, and has been arranged. The catalogue of this collection, for publication in the Garden Report, has been carried nearly to completion, but this publication will be deferred for the sixth Garden Report; and as yet no valuation has been placed on the books, so that they have not been added to the capital stock account. Exclusive of the Sturtevant gift, the library at present contains:—

Books	6,829	
Pamphlets	8,657	
Together	15,486 works, valued at	$25,268 52

An indexer has been kept steadily employed during the greater part of the past year on the card index of illustrations in the Garden library, and some 20,000 unpublished

* See Report for 1892, page 14.

sketches and manuscript notes of the late Dr. George Engelmann have been mounted on sheets and bound in 60 quarto volumes, not included in the preceding enumeration.

The Garden room at the Marine Biological Laboratory at Wood's Holl was again used through the summer of 1893 by Mr. M. A. Brannon, who continued his studies of Grinnellia, and it is expected that he will make similar use of it through the coming season,—my feeling being that it is better to have one piece of work completed in this way than to have several begun and left unfinished for lack of the facilities which the Garden can give.

So much of my time as could be spared from administrative and class work has been devoted to botanical study, and two small papers on systematic botany will appear in the fifth Report, while another is nearly ready for advance publication from the sixth volume. My general assistant, Mr. J. G. Smith, who succeeded Mr. Dewart in June last, has found time, in addition to his routine duties, to nearly complete a revision of the North American species of Sagittaria, which is expected to be ready for publication early in the year.

In addition to the regular publications for the year, the Garden has issued a second edition from the electrotyped plates of the first Report, the supply of which had become exhausted; and a small handbook giving in a concise form the principal facts about the Garden, and illustrated by a map and a number of half-tone illustrations of points of interest to visitors, has been published and placed on sale at the gate, at the nominal price of 25 cents per copy.

Four annual events provided for in the will of Henry Shaw have taken place during the year, namely: the delivery of the fourth annual flower sermon, on the 14th of May, in Christ Church Cathedral, by Rt. Rev. Thomas U. Dudley, Bishop of Kentucky; the fourth banquet of the Trustees of the Garden and their guests, presided over by Judge G. A. Madill, of the Board; the award of the third series of Shaw premiums at a floral exhibition, given under the

management of the Florists' Club of St. Louis; and the fourth banquet to florists, gardeners, and nurserymen.

The flower sermon will be printed in the fifth Report of the Garden, which will also include an abstract of the proceedings at the Trustees' banquet. The annual convention of the Society of American Florists in St. Louis in August last brought so many representative florists together that an invitation to visit the garden in a body was extended to them, which was accepted by about 300 delegates, on the tenth of August, on which occasion, by direction of the Board, an open-air collation was served, in lieu of the gardeners' banquet heretofore given in the autumn. In addition to the members of the Society, several distinguished European horticulturists were present, among them Mr. E. H. Krelage, of Haarlem, M. Jules Lemoine, Superintendent of the parks of Paris; Mr. George Nicholson, Curator of the Royal Gardens at Kew, England; Mr. Ludwig Schiller, in charge of the German gardening exhibits in Chicago; and Professor L. Wittmack, of Berlin, editor of the most important horticultural journal of Germany. The Director of the Garden and his assistants, the Head Gardener and foremen and their principal assistants, and the pupils holding garden scholarships, were also present. Owing to the informal character of the gathering, no speeches were made, but the guests were shown over the grounds by the garden staff, and made to feel at home in the Garden.

The Shaw premiums were offered last year for the same class of plants as in 1891 and 1892,* the amount awarded being $400.00. After consultation with the officers of the Florists' Club, the sum of $100.00 was reserved from the amount set aside for annual premiums, to cover the expense of preparing dies for a gold medal of the value of $25.00; and at its June meeting, the Board of Trustees of the Garden founded such a medal, "to be known as the Henry

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* Third Report, page 18; fourth Report, page 19.

CHRYSANTHEMUM MAJOR BONNAFFON.

Shaw Medal for the introduction of a valuable plant, and to be awarded each year, when practicable, for a new plant of value for cultivation, exhibited in St. Louis, as a part of the premiums or prizes to a flower show or exhibition provided for in the will of the late Henry Shaw; provided that the judges or other persons making awards at such exhibition shall certify that *said medal is awarded for a plant of decided merit for cultivation, not previously an article of North American commerce, and introduced to such commerce by the exhibitor during the year in which said award is made.*"

In accordance with a previous understanding, the Florists' Club this year offered this medal for a seedling chrysanthemum, and it was awarded to J. Dorner & Son, of Lafayette, Ind., for the chrysanthemum Major Bonnaffon; but it is intended that in future the medal may be competed for in any line of decorative horticulture.

In March last, the vacancy among the garden pupils mentioned in my fourth report * was filled in accordance with an announcement issued in November preceding. One of the pupils appointed in 1890 will have completed his course in April next, and an announcement has been issued, stating that the vacancy so arising will be filled then, in accordance with rules of the Board.

As in previous years, a number of botanists have visited the Garden and made use of its facilities for investigation, and various courtesies have been extended by the Garden to other similar institutions and received from such institutions, to the officers of which my thanks are tendered.

THE SCHOOL OF BOTANY.

Until the end of the last college year, Mr. Jared G. Smith acted as assistant and University Instructor in the School of Botany, resigning that position in June to be-

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* Report for 1892, page 17.

come my botanical assistant at the Garden. Since the beginning of the present college year, I have been assisted at the School by Mr. Charles H. Thompson, who came to the School from the Kansas Agricultural College. During the college year 1892–3, three special students met at the Garden for systematic work, and two special students were provided for at the laboratory through the year, and two others during a part of the year. One advanced student from a distance spent the summer at the Garden in a study of economic mycology. In the spring term, a class of eight teachers was occupied at the laboratory of the School with a study of native flowers, under the charge of Mr. Smith; and through the same term I conducted a class of fifteen teachers at the Garden, for a study of trees. A class of twenty-five children was also taught at the Garden by Mrs. F. W. Wislizenus, through the spring. Throughout the year the undergraduate classes of the University were taught by myself and Mr. Smith, the laboratory work being left largely in his hands.

In the first paragraph of the second clause of Henry Shaw's will, certain property is bequeathed to Washington University, "the income of which is to be used solely for the maintenance of a School of Botany; said income to be used exclusively to pay the salaries, and to defray the necessary incidental expenses of those engaged in botanical instruction, and researches at the Garden, and as need may require also within the precincts of the University; also for the maintenance of the requisite botanical laboratories, and their equipment with instruments and appliances for illustration and investigation, for the maintenance and increase of a botanical library and herbarium; and for such like objects strictly german to a School of Botany."* To secure harmonious co-operation of the School with the Garden, Mr. Shaw, in the second paragraph of the same clause, requires that the professor and teachers in the

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* Garden Report for 1890, page 36.

School of Botany shall be appointed from the Garden staff, or on the nomination or with the approval of the Trustees of the Garden; and to prevent the School from suffering from too great depreciation of its endowment, it is provided that whenever the net income of the School shall fall below $3,500, the Board of Trustees shall pay over to the University such sum as may be required to make the annual income $3,500.

When the School of Botany was opened, in 1885, its income was something over $5,000 per year,* but subsequently the revenue property was vacant and it was found impossible to again so rent it as to secure even the minimum of $3,500 specified by Mr. Shaw.† Question having been raised as to the authority of the Garden Board to make good the deficit in the manner indicated in the will of Mr. Shaw, because of his having transferred to Washington University during his life-time, the endowment property mentioned in the will, but for the purposes therein specified,‡ the instruction of the courts was asked, and on the twentieth of February last, an opinion was handed down by Judge Valliant, of the Circuit Court, authorizing the Board to make good such deficit in the future, and embodying a decree covering the amount of the deficit up to that date. This opinion, therefore, insures the maintenance of the School of Botany on the basis contemplated and intended by Mr. Shaw.

As a result of a conference between the managing boards of the University and the Garden, a readjustment was made of the proportion of the Director's salary paid respectively by the Garden, and by the University for services as head of the School of Botany, which liberates a considerable sum each year, previously paid on that salary, but now set free for other uses of the School. During the present year the surplus will be largely spent in secur-

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* First Report, page 60.
† Second Report, page 19.
‡ First Report, page 61.

ing needed additions to the instrumental equipment and library of the School, in preparing for the series of eleven undergraduate electives now offered by the University; but it is expected that an additional instructor, probably a specialist in lower cryptogamic botany, will be engaged at an early date. The adoption of a liberal elective course in the undergraduate department of the University gives promise that botanical work of value may now be done with students in regular attendance on the University. As these courses involve the expenditure of more of the time of instructors than it has heretofore been possible to utilize with undergraduates, the announcement in the University catalogue of special classes such as have been indicated in my former reports,* and mentioned above as having been conducted during 1892–3, has been discontinued by direction of the Advisory Committee of the School of Botany.

In closing this report, I wish to express my appreciation of the courtesy and interest of the Board, as manifested through the year, and of the faithful service rendered by my assistants, both in the School of Botany and at the Garden.

Very respectfully,

WILLIAM TRELEASE,
Director.

January 10, 1894.

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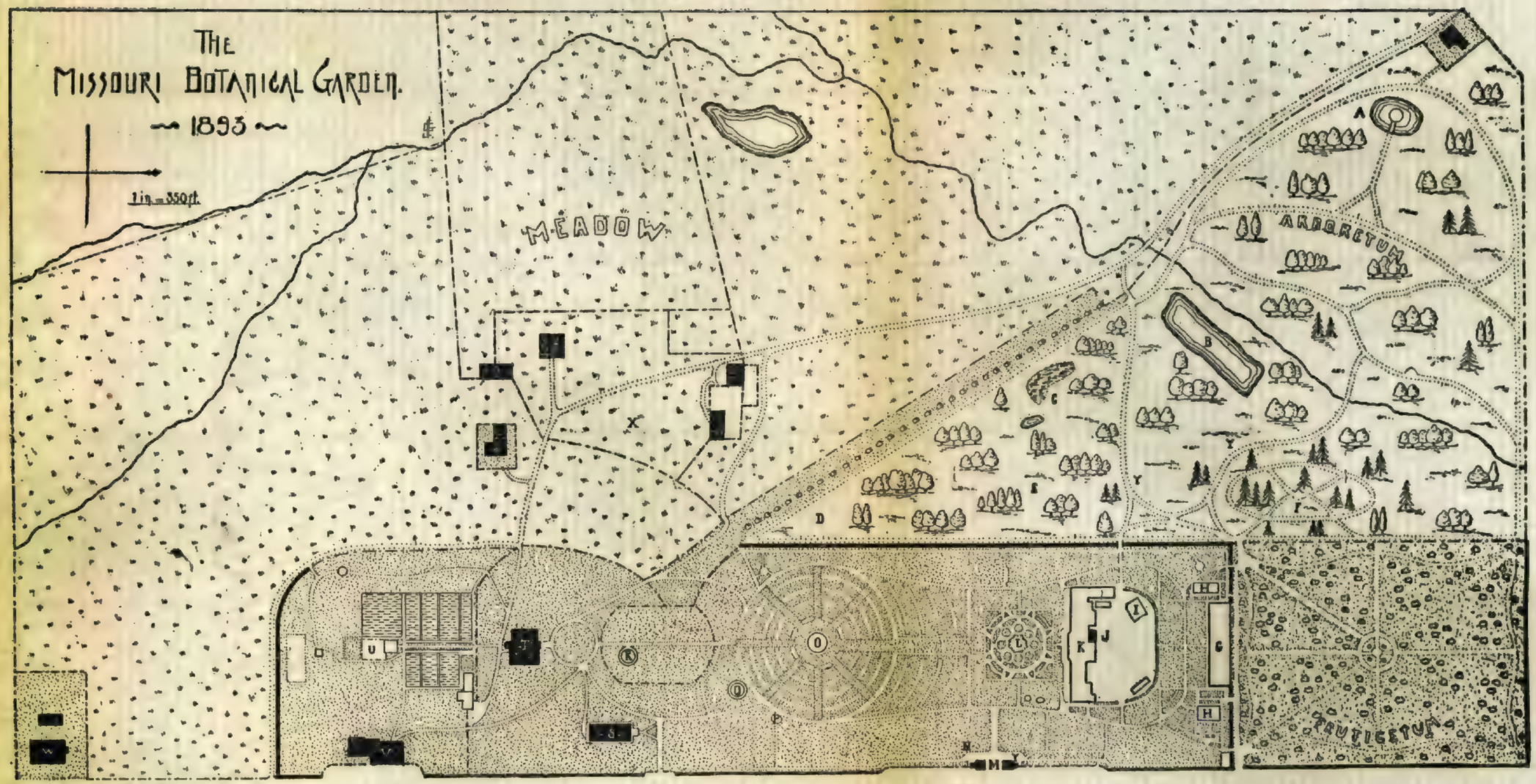
* Garden Reports, i, pages 84–86, and 100; ii, page 32; iii, page 19; iv, page 20.



(The bottom of the map faces on Tower Grove Avenue, Shaw Avenue is at the right and Magnolia Avenue is at the left.)

A. Lily Pond.
B. Willow Pond.
C. Bog.
D. Cactus Rockery.
E. Wild Garden.
F. Conifers.
G. Linnean House.
H. Small Rockeries.
I. Warm House.
J. Head Gardener's Office.
K. Main Greenhouse.
L. Parterre and Statue.
M. Main Gate.
N. Drinking Fountain.
O. Observatory.
P. Drinking Water.
Q. Statue.
R. Mausoleum.
S. Museum.
T. Residence.
U. Vegetable Garden.
V. Herbarium and Office.
W. Lodge.
X. Farm Buildings.
Y. Toilet.

ANNIVERSARY PUBLICATIONS.

FOURTH ANNUAL FLOWER SERMON.

BY THE RIGHT REVEREND THOMAS U. DUDLEY.

And they heard the voice of the Lord God walking in the garden in the cool of the day. — Genesis, iii, 8.

I am summoned hither to-day by a voice long silent in your busy streets. It seems to me that an aged man, a stranger to me, but whose beneficent features are well-known in your community, has put into my hand a beautiful scroll, all glorious with color, and fragrant with the perfume of the spring-time, and bids me read the interpretation thereof to the people of this city which he loved. Day and night through long years his eyes did rest, with ever new delight, upon this writing of mysterious beauty. All time and thought and wealth he gave to provide largest, fullest, plainest copies of the writing; and men to labor for their preservation, their perfection, their elucidation. And once in the revolving year, when the illuminated text is most gorgeous in the sunshine of the May days, he calls the preacher, not to explain the minute perfections of each tiniest letter, or the significance of the slightest variation, for these the Professor and the expert are here to declare, but a preacher to proclaim whose is this wondrous handwriting, and what the message it was made to tell. For this I am come, to bid you mark "the wisdom and goodness of God as shown in the growth of flowers, fruit and other products of the vegetable kingdom;" the glory of God in the creation of "the green things of the earth." This is the word I am come to speak, "Behold the glory of God."

I am come to bid you mark that now as in the first day of man's life upon the earth, the Lord God doth walk in the garden in the cool of the day. I am come to bid you mark that, however or whenever man was created, whether by the direct fiat of the Almighty will, or by the long process of the centuries, by slow evolution from the deep sea slime; whether immediately from the dust of the ground, or mediately by self-directing development from the lower forms of life; that somewhere and somewhen there came a day in which the Lord God did breathe into his nostrils the breath of life, and man became a living soul, fashioned in the image of God, capable to conceive of Him by whom he was created, and to read the revelation of His glory in star and mountain, in forest and stream, in flower and fruit. Yes, that because man is man, that therefore to him the invisible things of God from the creation of the world, are clearly seen, being understood by the things that are made. Though no cloudy pavilion had ever rested upon Sinai's summit, though no voice had ever thundered thence the unchanging commandment, the adamantine rocks had ever cried aloud unto man: "I am the Lord thy God, unchangeable, everlasting." "The stars in their courses" had still fought against the Sisera of denial and sin, and compelled the confession of the only God. "The fruitful trees and all cedars" had still forbidden that man should fall down and worship an idol made from the stock of a tree. The babbling brook and the rushing river had alike proclaimed that there is a river of life, even God Himself, the Creator who alone can satisfy the thirsty soul of His child. The whole earth is full of His glory; the whole creation is framed to declare unto man the name, the character of God, for "The glory of God is God's character shining forth before His creatures' eyes that it may call forth their admiration."

But I am limited by the conditions of the foundation whereon I stand to-day, to the consideration of the particular elements of the character of God which are made

plain by the fair beauty of the Garden. To-day we may listen only to the gentle voices of the green herb, and the unfolding flower. Perhaps it is less difficult to see the right hand of Omnipotence in the destroying thunder-bolt than in the decorated petals of the lily; perhaps His voice is more easily discernible in the roar of the whirlwind than in the whispering of the waving wheatstalks as they praise their Maker. Yes, doubtless the angry frown of the storm-king commands attention and audience from men who never see His smile amid the valleys laughing and singing because they stand so thick with corn. And therefore the more necessary that the preacher shall strive to point out that in these, too, are clearly seen "the eternal power and godhead;" that His gentler utterances in the garden, as really as His angry voice in the fiercest conflict of furious elements, alike declare the glory of God.

Mark then, first, that "eternal power and Godhead" are witnessed unto as perfectly and as incontestibly by the tiniest floweret that gems the sward to-day, as by the orderly procession of the stars about their central sun. Alas! to man in general, like the potter in Wordsworth's poem, —

> "A primrose by a river's brim
> A yellow primrose was to him,
> And it was nothing more."

But to the thoughtful student of the mysteries of nature, here is wonder as great, and problem as insoluble, as in the wild rush of the Borean cohorts, and just as sufficient evidence of infinite power and Godhead.

Ah! my brother-man, come explain for us the germination of the dead seed which for so long has lain concealed in the sepulchre of the earth. The cerements of death have been broken, thou canst not tell how, and beauty has come from ashes, life from death, arrayed in splendid garment of praise to the life-giver, and the spirit of heaviness is no more. The yellow primrose is banner of victory,

and on its folds is written in letters large and free, "Eternal power and Godhead."

But I mark that special revelation of the glory of God, even of His character, is made in the flowers and fruits of the earth, that is not to be found in the writing upon the mountains and the seas. And I mention first the assurance given in them of the will and purpose of the Creator to provide gratification and satisfaction for every instinct and appetite of man, the lord of nature, man, its climax and master. In the old record of the genesis of all things — history or poetry, dear friends, it matters not which it is, for poetry often contains so much more of essential and valuable truth than history — in that oldest record we read how the Lord God did give to man dominion over everything that he had made. "Every herb bearing seed which is upon the face of all the earth, and every tree in the which is the fruit of a tree yielding seed," to man was it given for meat. But see, more than this, when bodily hunger has eaten and is full, what abounding provision is made for the gratification of eye and nostril, of the mysterious love of the beautiful. The toiling artisan, the thousand-handed spinner of to-day, doth vainly endeavor to fashion the fabric whose velvet softness shall not be as haircloth by the side of the delicious touch of the lily's coat. The artist has not yet learned, after his centuries of endeavor, to mix the color which can bring the joy to the eye which flares from the rosetree, or soothes with its gentle radiance from the green sward. The chemist cannot distil the fragrance that fills the woods when the summer rain has evoked from the wild grape her wealth of perfume. Behold, here is life, life in glorious beauty, created to bring joy and gladness, satisfaction, delight to man! Shall man who cannot with all the experience of generations attain unto the very least of this excellence, shall man not wonder and adore the eternal power and godhead here manifested? Nay, shall man not learn with adoring wonder that beside power and godhead there is here manifested

the love of a father for his child, who giveth him all things richly to enjoy; that goodness with power is met, that wisdom and love are joined in infinite embrace?

And more than this, if God so clothe the grass of the field, if God thus declares himself the careful fabricator of that which is useful only because it is beautiful, which brings help only because it brings delight; I ask not now, with the great Revealer, "Shall he not much more clothe you, O ye of little faith?" but I ask, shall not man learn that beauty is good, that the ministering of happiness is legitimate object of human effort? I bid the commercial spirit of our age, the demon who possesses the vast multitude of our countrymen, come walk in our garden in the cool of the day, and hear the voice of the Lord God proclaiming that dollars and cents are not the only measure of value, that utility is to be determined by other tests than capacity to feed a hungry body or to protect it from the heat and the cold; that man doth not live by bread alone, but by every word which proceedeth out of the mouth of the Lord doth man live, and that here are other words than bread, even beauty and harmony and perfection. Come hear Him declare by the works of His hand that man's every hunger must be satisfied, if he shall grow up into the fullness of the stature of the manhood that is to be, into conscious sonship of the Eternal Father. Come hear the Lord God asserting by His garden's beauty, that thy money for which thou art laboring, for whose accumulation thou art rising up early and late lying down to rest, is worthless in thy coffers, but is valuable only as it doth enable the satisfying of the natural hungerings of the Godlike creature. If God so clothe the grass of the field, shall not I, His son, make beautiful with all the resources at my command, the home where dwell my children? Yes, I will summon the artist to whom the Creator has given in largest measure the vision divine that seeth things that are not, and the creative skill that makes them to be, that he may build my home in lines of beauty, and ornament

its walls with colors in peaceful harmony; that he may teach me to fill its halls with objects rich and rare whose beholding shall make more keen my children's hunger for the truly beautiful, and satisfy while it sharpens. I will give bread for his body's need, and gold for his labor if he will give me in return the beautiful and teach me to avoid and to hate the ugly, the foul, the base. For if God so clothe the grass of the field for man, must I not like Him strive to satisfy every hunger of the spirit of my child?

And this leads me to remark upon another special revelation made in the garden where we wander, even that upon cultivation and environment will largely depend the character and the excellence, the kind of flower and the quality of flower, which shall make glad or make sorrowful the home-garden which it is given me to keep. So is the will of God the Creator that upon man's own care and diligence shall in largest measure depend the progress of the race, the attainment of "that one far-off divine event toward which the whole creation moves." Come see under the guidance of those competent, as I am not, to lead you, how the wild rose of the forest has been literally transformed by the wise training of the masters of floriculture. Compare the poor little waif in her close clinging pink gown, whom you have met on many a barren hill-side, with the "American beauty" in her wide flowing crimson robe, tossing her head in proud superiority and exhaling with every movement a perfume to intoxicate the senses. Come measure the giant strawberry nestling in its luxurious bed, luscious with sweetness and full to bursting of the sunshine, and then look on its poverty-stricken ancestor, sour and tasteless, bringing no satisfaction to the timorous hunger which is bold to consume it. Nay, come see how by wise training, by careful development, have arisen these varieties manifold of almost every flower and fruit, all close of kin, each group sprung from one common ancestor, and he so utterly unlike his descendants as almost to deny that kinship. Behold the glory of God! Learn that it is the will of God

that variety shall characterize the works of His hand, and that such variety He wills shall be brought about by the colaboring with Him of the man for whom all else was made.

Heredity and environment, original nature and artificial development, these the conditions to determine character and quality of flower and fruit, for the operation of the natural laws is unchanging and unfailing; seed time and harvest, summer and winter, the sunshine, the dew, and the rain, these shall be for all alike.

Shall it not be so, as well, in the home-garden where the branches of the fruitful bough run over the wall?

Heredity, alas, that most awful law in God's universe, will still hold its sway. The sins of the fathers shall be visited upon the children; the tree must bear fruit after its kind. And thanks be to God, the dew from heaven, even the spirit of grace doth never fail, for the covenant is sure, and the sunshine of prosperity, the rain and the storm of trial, all these are like the summer and the winter of the natural world. Then the environment, the environment, what shall it be? The training, the development, this is ours to determine, and so in large measure the resulting character and perfection of the flower or fruit. "Can any good thing come out of Nazareth?" was the natural question of the old time. No matter how good the seed planted, no matter how regular and unfailing the sunshine and the rain, can any flower bloom in that fetid atmosphere, can any fruit come to perfection under such conditions of mildew and blight? We know the secret of the growing there of the very flower of humanity, the absolute perfection of manhood, but men and brethren, still I plead that we learn the special revelation of God in the flower garden, that by careful training we may change the character of the plants we are given to cultivate; that upon the environment of these homes will depend in large measure what our sons and daughters shall grow up to be. As well may our gardener expect the new product of peculiar beauty if he shall give

nor time nor thought to its propagation, as we look for the new manhood of intelligence, integrity and devotion to duty, the new womanhood of purity and gentleness and helpfulness, without the watchful care of every surrounding which are necessary for their product. The gardener will suffer no association which can by possibility bring disastrous result to his experiment; the soil will be selected as with a microscope, to be the home of the tender slip which may bear the hoped-for treasure, and all assistance, all protection, which science and experience can suggest, will be given, that the longed-for transformation may take place. Because this is the revelation of God, that in so doing success may be attained. And the revelation is to us, men and brethren, that association with evil persons, places, things, will prevent the development of the fair flower we are seeking; that the home-soil must be carefully prepared, that all stones of offense must be cast out, all clods of unyielding prejudice broken to powder, the fructifying additions of attractiveness must be brought, even objects of beauty, occupations of interest, sympathy with youth's pursuits; that the atmosphere must be sweet and clear, and the barriers which obstruct the sunshine taken away; and above all that the heavenly influences of God's grace and spirit must find ever open access; else the tree will bear fruit only after its kind, the son will be no improvement upon his father, the will of God will not be accomplished in the steady and regular advance of His creation.

Again I can hear another word from the Lord God in the garden in the cool of the day — 'overcome evil with good' — that this is the method of the Divine government, this the glory of God, the character of the Father, revealed for the admiration and the imitation of His creatures. Evil is there as everywhere in this present world, mysterious intruder upon the vast domain which God did once call good. I cannot understand or explain its existence there or anywhere else. I cannot understand why tares are growing in the field to-day along

with the wheat; I cannot understand or explain why the noxious deadly weed springs up close by the flower fragrant and beautiful or the green herb, sweet food for beast and cattle and man; I cannot understand the vigorous life of the pestilential plant which uncontrolled by man runs riot over wide field and kills the life of the green grass. But I can understand that I behold, how the wisdom of man learned by experience, even the same wisdom that God hath written in other books by His servants the Prophets, may strengthen the good that it shall overcome the evil. But see how constant, how unceasing, are the gardener's care and diligence to prevent that thorny enemies shall destroy the young life of his plant; how not once or twice, but again and again, day after day, he doth pluck them up by the very roots, and yet it is probable, in the very handling doth scatter the seed to quickly spring up as new enemies to be again assailed. And all the time he strengthens by culture the growing plant, that by and by it may be itself strong enough to resist the invader who would occupy its home. But the evil will always threaten the life of that which is good until the end come and all evil shall have been cast out of God's world. In less time than was required to make the wondrous garden wherein we walk to-day would it revert to a condition of primal waste, if left to itself, uncultivated, abandoned by the master; but the time shall come when good shall have been made so mighty everywhere that evil shall be powerless to overcome it, and the Lord God shall walk amid His redeemed ones in the garden of the new earth wherein only righteousness shall flourish. To help forward and onward this glorious consummation, He calleth to us ever, by every voice that soundeth, from flower and shrub, from tree and vine, from man and beast: "Overcome evil with good." "The whole creation groaneth and travaileth in pain together until now * * * waiting for the redemption." Therefore dig down deep in every garden of thine own soul, of thine own household, of the city wherein thou dwellest, of the nation whereof

thou art citizen, dig down deep and eradicate all evil, evil principles, evil practices, evil men. But leave not the ground empty and unoccupied which the thorns have filled; nay, plant therein the good seed, watch it, nourish it, for enemies will be ever at hand to destroy it. Make righteous principles to take the place of the evil; make honest methods to supplant the fraudulent; make good men and true thy rulers in place of the venial and corrupt. Overcome evil with good.

Again I can hear the voice of the Lord God as we walk in our garden, speaking unto us, "My mercy is over all my works." See the sun doth rise on the wild sage of the western desert, and upon it the rain doth fall, as unfailingly as upon these most wonderful products of scientific cultivation. Nay, see that the eternal power has been exerted, and the Godhead's wisdom exercised as fully in the creation of the valley's lily who hides her snow-white face beneath her green veil, as in that of the giant king of the forest who gleefully shakes his arms in the very face of the storm and makes no obeisance to any power. And come note that the microscope discloses miracle of perfection in the curious fabric of the fern leaf, more wonderful perhaps than in that of the mammoth palm tree, though all here is miracle. Hear, ye men, the revelation of the garden. His mercy is over all His works, and therefore supremely over all men. All are His children, and with an infinite love He loveth all, yes, all, and not any number heaven-chosen, or privileged by their own attainment; all, not one race sprung from any faithful Abraham, for all are Abraham's sons who will be. Is my home amid the obscurity of poverty, the sorrows of affliction, the weakness of ignorance, then still I may find the type of my condition in the "violet by the mossy stone," almost hidden from the passer-by, and He careth for me, He knoweth me, and I may fulfil my destiny and show forth His glory. Am I accounted great in the world's esteem, do I stand ever in the view of men, and do all the undergardeners minister unto me because I

am the chief adornment and prize of the garden? Still am I in the greater danger from envious hand or tongue; the rich soil gathered about me is most tempting allurement to the thorn which would rob me of my food; the golden noon soon passeth by, and the autumn draweth on apace when my flowers must fall and die. But I too may rejoice though I tremble because His mercy is over all His works.

Again I can hear the voice of the Lord God as we walk in our garden, saying, "first the blade, then the ear, after that the full corn in the ear; so the earth bringeth forth fruit of herself." Look about you and see the fields today are decked with living green; the blades stand close together and dance with delight in the sunshine. Not many weeks shall pass before each shall don his cap of clustering bloom, and then anon the bloom shall disclose the crowded company of hard yellow grain. But see, all shall be in due order and progression. It were a thing unheard of that the full ears of corn should spring unheralded from the furrows, or that in harvest time the field should still be green with waving blades; either result we should alike call failure. Ah! here is revelation of the wisdom of God that we need to learn. Here is ample condemnation of the impatient spirit of our age, in church and state alike, that cannot wait for the due procession of the suns, but demands immediate, impossible fruitage ere time has been given for even the blade to appear; and will angrily refuse to labor any more when such visible, tangible evidence of growth is naturally and necessarily lacking. Mark you, the fruit that appears before the time of fruitage is bastard and worthless; as just as certainly the exhibition of nothing but leaves when the time for the ingathering is come is proof of disease, and failure and death. Am I angry over the recorded immorality and savagery of the ancient people chosen to be the very seed corn of the new humanity? Am I in insolent unbelief ready to abandon all faith in God, all hope for man,

because the Hebrews, apparently by divine command, were guilty of enormities of conduct, which from our stand-point of development are inconceivable? Ah, friend, hear the voice of the flower and of the field proclaiming that this is God's method for the education of the world, for the bringing in the kingdom of righteousness, for the "purifying unto Himself of a peculiar people zealous of good works;" "first the blade, then the ear, after that the full corn in the ear." Am I so disappointed over the results of missionary operations, that I am ready to abandon the effort to evangelize and to educate the heathen abroad, or the worse than heathen at my own door, and to consent to the pessimistic despair of the age, that all things are worse than in the days of our fathers, that man despite all the influences of church and school, of science and sermon, is more bestial than ever? Ah, friend, hear this word of the Lord God in the garden. Expect not the flowers until the month of the flowers is come; expect not the red clusters of bursting grapes until the summer is past.

Am I bitter against the children of my family, because despite my endeavors to make them know the unreality and the vanity of their chosen pursuits and pleasures, they will not let them go; that their very code of duty seems different from mine; that frivolity and merry-making are their chief concern; that they see not as I would fain show them, that life is dying and death is living? Oh, my brother, learn the revelation of the flowers, that God hath made them so, that theirs is now the tender joyous life of the blade of corn which has not eared, while to thee has come the bearded, tasselled ear, that already groweth hard and rough, and maketh ready for the garner. Recognize that the presentation by them of the life of the spirit in form as developed as thine, would go near to prove that it was unreal and valueless, for the full corn in the ear is not yet due. Rather rejoice in the fragrance of the young life about thee; let its aroma of freshness, its glorious

spring coloring rejoice thine eye and thine heart, for the life is verified by the bud and blossom as truly as by the rounded fruit.

And lastly I think I can hear the voice of the Lord God in this our garden, speaking unto me from bursting seed, from bud and flower, bidding us to go quickly to another garden in a far away land. And as we come thither we note that in the garden is a sepulchre. The great stone that did guard its entrance lies far away from the door of the tomb, and on it sits an angel descended from heaven. His countenance is like lightning and his raiment white as snow. He speaks: "Fear not ye, for I know that ye seek Jesus which was crucified; He is not here, for He is risen as He said." The Roman soldiers who had kept guard over the tomb lie prostrate on the ground. Some poor women who came to anoint the dead body, have heard the words of the angel, and are gone to the city to bring hither some of the men who were the friends of him who here was buried. The men draw near and enter into the rock-hewn chamber. We may enter with them and see the linen clothes which had enshrouded the dead body lying in well ordered array, with the napkin that was about His head, wrapped together in a place by itself. And we depart with the two visitors, wondering, wondering in ourselves at that which has come to pass. Ah, can I believe it, can I believe it, that life and immortality are indeed brought to light, that He who was really dead is as really alive forevermore? And I can hear the voice of the Lord God walking in the garden, saying unto me, why not? Canst thou understand the Easter of the flowers? Canst thou understand why or how the dead seed at the end of the days of My appointment doth leave its clothing in the dark prison-house and come forth with new and glorious life? But thou dost believe. Is the "eternal Power and Godhead" made plain in the creation of mountain and sea, river and forest, fruit and flower, is it unequal to bring back new life from the grave? Is this thy difficulty that God *could not* raise Jesus

from the dead? Then is man the servant and subject of a ruler whose power is limited, and on this theory more than before, is the universe an inexplicable mystery.

But hast thou not learned from the flower garden that one feature of the Creator's character is the will and purpose to provide satisfaction of every human instinct that He has implanted? How then, if the flowers speak true, shall there be no answer to the universal longing for life, life unending, life full and free and boundless?

Hast thou not learned from the flowers that the Divine purpose and plan is the progressive education and elevation of man, the bringing to perfection of this last supreme development of life? And shall the most successful pursuit of this ideal end in darkness and nothingness, when the little path of three score years and ten shall have been traversed? The flower whose splendor has illuminated our garden through all the summer time is withered and dead when the winter comes, and its shriveled leaves lie in a mouldering heap about the place over which its beauty triumphed. Aye, but the life is there in stalk and stem, and when the spring-time comes, by operation of the unchanging law, even the law which the Creator did give "which shall not be broken," new bud and blossom shall again make glad the waiting servitor. Why, then, if the flowers speak true, why shall not man die and yet live again? Why shall the unchanging law here find violation, even the law of the flowers, the law of progress, unending progress?

Nay, man hath not seen his brother arise from the grave, and the stories ye tell of this Jesus who was crucified, are but the legendary halo which His followers have painted above His head; are but the answer of ignorant desire to the longings, natural and universal, for immortality.

But hear again the word of the Lord God among the flowers,— "First the blade, then the ear, and afterward the full corn in the ear." We know not yet the law of this human revival and reflowering. But a man might grow old waiting for the blossom to form upon his century-

plant, and die believing that they had been deceived who had reported its flower in a year long before his guardianship began. We know not the day nor the hour when the general resurrection shall be; when all who are in their graves shall hear the voice of the Son of Man and come forth; but once we know, yes, we know, the grave hath given up its dead. If this be not established by human testimony, then can nothing be. And the voice of the Lord God in the garden to-day declares so it shall be with all men. The laws of the universe demand it. But when, ah, when, none knoweth. The corn of wheat falleth into the ground and dies, but by and by, when the appointed period is accomplished, when the blade and the ear of preparation have been fulfilled, after that the full corn in the ear, the life full, perfect, complete!

O men, hearken unto the voice of the Lord God in the garden — "Verily the invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead."

O men, are ye not without excuse, thus knowing God, if ye glorify Him not as God and are not thankful?

AMEN.

PROCEEDINGS OF THE FOURTH ANNUAL BANQUET,

GIVEN BY THE TRUSTEES OF THE GARDEN, MAY 19, 1893.

The fourth of the annual banquets to the Trustees of the Garden and their guests, provided for in the will of Henry Shaw, was given at the rooms of the Noonday Club of St. Louis, on the evening of the nineteenth of May, covers being laid for about seventy persons. The gathering of scientific men on this occasion was quite notable. Among those present were:—

PROFESSOR T. C. CHAMBERLIN,
University of Chicago.

M. DWIGHT COLLIER,
New York City.

PRESIDENT H. T. EDDY,
Rose Polytechnic Institute.

PROFESSOR G. L. GOODALE,
Harvard University.

PROFESSOR ASAPH HALL,
U. S. Naval Observatory.

PRESIDENT J. D. HAMMOND,
Central College.

PROFESSOR A. S. HITCHCOCK,
Kansas Agricultural College.

PRESIDENT R. H. JESSE,
University of Missouri.

DR. GEO. G. KENNEDY,
Boston, Mass.

PROFESSOR T. C. MENDENHALL,
Supt. U. S. Coast Survey.

PROFESSOR H. W. NORRIS,
Iowa College.

CHARLES ROBERTSON,
Carlinville, Ill.

PROFESSOR W. B. SMITH,
University of Missouri.

PROFESSOR M. B. THOMAS,
Wabash College.

PROFESSOR L. M. UNDERWOOD,
DePauw University.

PROFESSOR C. O. WHITMAN,
University of Chicago.

GEO. D. BARNARD,
A. D. BROWN,
D. S. BROWN,
W. M. BRYANT,
DR. C. O. CURTMAN,
JUDGE DANIEL DILLON,
DR. W. E. FISCHEL,
HON. D. R. FRANCIS,
REV. J. H. GEORGE,
JUDGE MOSES HALLETT,
JEROME HILL,
E. A. HITCHCOCK,
PROFESSOR J. B. JOHNSON,
GEORGE E. LEIGHTON,
I. H. LIONBERGER,
J. H. MAXON,
T. A. MEYSENBERG,
J. S. MOFFITT,
HENRY L. MORRILL,
I. W. MORTON,
HON. J. W. NOBLE,
CAPT. C. F. PALFREY,

A BED OF ORNAMENTAL GRASSES.

CHARLES PARSONS,
PROFESSOR W. B. POTTER,
DR. T. F. PREWITT,
DR. ENNO SANDER,
HENRY C. SCOTT,
JOHN SCULLIN,
JUDGE J. A. SEDDON,
GEO. C. SMITH,
I. M. STURGEON,
JUDGE SAMUEL TREAT,
EDWARDS WHITTAKER,
of St. Louis.
GIST BLAIR,
J. W. BRANCH,
CHANCELLOR W. S. CHAPLIN,
GEORGE S. DRAKE,
HENRY HITCHCOCK,
D. F. KAIME,
R. J. LACKLAND,
GEORGE A. MADILL,
PROFESSOR H. S. PRITCHETT,
BISHOP D. S. TUTTLE,
JAS. E. YEATMAN,
Of the Board of Trustees.
A. D. CUNNINGHAM,
Secretary of the
Board of Trustees.
WILLIAM TRELEASE,
Director of the Garden.

At the conclusion of the dinner, the Chairman, Judge George A. Madill, introduced Professor George L. Goodale, of Harvard University, who spoke as follows:—

MR. CHAIRMAN AND GENTLEMEN:— Your very cordial greeting may be fairly interpreted as an expression of your good will to the ancient University which I have, for the moment, the honor to represent. Permit me to say that the Botanical Department of Harvard reciprocates this good will. Our interest in your affairs is natural and deep.

The three professors in the department of botany in Harvard can never forget the solicitude with which their associate and master, Asa Gray, watched the last steps in the transfer of the Shaw trust. When he had assured himself that the Shaw Garden was to be something more than a magnificent personal memorial, that it was to be the repository of the botanical treasures of his life-long friend, George Engelmann, and that it was to be something even more than this, namely, a center of scientific activity, his pleasure knew no bounds. And when a little later he was influential in securing as Director of the Shaw School of Botany, William Trelease, whose sound, practical judgment, whose indomitable energy and whose stimulating power of investigation he held in the highest esteem, he felt that the future of the Shaw foundation was secured.

Therefore to-night I can say to you frankly and without reserve that after two days spent in a very close and critical examination of the Garden and its attached establishments, and after having listened to the well-matured plans of the Director, I can have no hesitation about saying that we may congratulate you to the fullest extent upon the realization of the plans of Professor Gray, and upon the rapid and symmetrical development of what we may call the Shaw Institution.

It is often said that lookers-on see more of the game than the players. Now as a botanical looker-on, may I venture to express the pleasure I have felt in what I have seen, and to make a very few suggestions, which I trust may not seem, in any proper sense, officious or ill-timed? In the first place, you have here an establishment which occupies a unique position. I know of none like it in the world. It is not because its income is so vast, nor because its plans are very far-reaching, but it is because it is the gift of a private citizen to the world. You may have thought of the Shaw Garden as a St. Louis park, but the influence of this Garden is not limited to your city, it is not confined to your State, nor even to our nation. It progresses upon lines which Asa Gray and George Engelmann traced out, and which, held true by you, will make its power felt profoundly for good, throughout the world.

It seems to me not inappropriate to occupy the short time which has been assigned me in saying a few words in regard to the utilitarian aspects of the Shaw Bequest. We can understand one another better, if first of all we bring to our attention what Botany is. It is not an elementary school-girl's study; it is not merely a pastime for superannuated naturalists; but it is a science which endeavors to answer every reasonable question regarding plants; and it was in this sense that Henry Shaw, George Engelmann, and Asa Gray understood it.

Now what are the aspects in which we look at plants, and what questions can we ask? You will say at once that

these questions fall into a few catagories. Suppose we had only one plant in the world, for instance the wheat plant. What questions could we ask in regard to that, — in regard to its wonderful organs, by which it brings from earth, and water, and air, all the materials from which it creates food? These organs possess a most marvelous adaptation of means to ends, and present to every thoughtful person objects of severe and yet attractive disciplinary study. Passing from this, let us see the plant in action. The plant is taking from the soil and water, and is drinking in from the air, one of the waste products of animal life and activity, and out of these is creating food. It is making that which stands alone between the animal world and starvation. If all plant activity were to cease upon this planet, starvation would stare us in the face, for all food is created first or last by plants. But plants are more than mere store-houses of food. They are treasuries of force. They hold within themselves energy which they have borrowed from the sunlight. This night we have before us resplendent filaments from which light of the coal period flashes back to us. These radiant threads are simply giving back to us the sunlight of that dim past. The relations of the plants of that past to our present involve questions of absorbing interest for the botanist to answer. To examine these questions he must have at command all the appliances of modern chemistry and modern physics; therefore let me venture to make as my first suggestion to the trustees of the Shaw Foundation that they must not limit their Director when he undertakes investigations in regard to what we call the laws of vegetable life.

These pressing and utilitarian questions must be answered somewhere. Where can they be approached better than here where you can place at the disposal of the Director and his students everything required for exhaustive research? The unfolding of the laws which govern all plant life is a condition antecedent to the highest use of plants. The world looks upon that task as largely in your hands.

Now suppose, instead of having a single plant, which we have taken as an illustration, we have many plants before us. Our first duty is to compare them and bring out the points of likeness and of difference; this is the work of Systematic Botany. It endeavors to discern the relationships of plants. The word relationship is no longer a mere figure of speech. It is to the science of to-day a definite expression of an existing fact. Looking around and behind us, we trace these affinities. The maples which shade the Shaw grounds to-day came from ancestors which were maples of the later geological periods. In like manner the chestnuts, the oaks, and the elms may be carried back into geologic times, and we find their traces in the strata lying somewhat west of where we are now gathered.

Is there a grander field of thought than that on which the past and present meet? I know I am right when I say that you will not hamper your Director when he sets students at work investigating questions in regard to these relationships. Some of these questions belong to what has been unhappily called "pure" science. It is to be regretted that the word pure was ever used in this connection, because it seems to indicate that there is something contaminating in the touch of that which is its antithesis, ordinarily termed applied science. The fact is, all science is sooner or later applied, and of no science is this more exactly true than of Botany, which has innumerable applications to all phases of human life.

I pass now to one or two of the practical applications of our science. I ask you first, where can one better study or set students about studying an improvement in our food plants than right here? If you look for a moment you will remember that by cultivation, by selection, by hybridizing, by the thousand appliances which man has within his grasp to-day, we can guide plants in almost any direction we please. The laws of heredity, the laws of variety are becoming, thanks to the students of Biology, better understood day by day, and they can be utilized. Let the

Director never be cramped for money or men for tasks like this. It belongs to the highest class of applied scientific work.

To show you that others feel as I do about your magnificent establishment, let me tell you that there is a citizen of Massachusetts whose work in the improvement of plants has been largely done in that state and the State of New York. To aid him in his researches, he has accumulated a very large collection of books antedating Linnaeus, by whom this sort of work was done about the middle of the last century. Anterior to the time of Linnaeus, many great botanists had written upon plants, had recorded their impressions and made their drawings, so that we find in the record, imperfect as it is, descriptions of these varieties which Linnaeus and others have regarded as improved. To collect and study these books has been his passion; to get these books together in order to obtain the earliest possible views regarding all the varieties. Having brought these all together at great cost and labor, he sought a place for their preservation. Where could there be a better place to keep them than in the noble library of the Massachusetts Horticultural Society, or in the library of Harvard University? Yet this citizen of Massachusetts sends them where? To the Shaw School of Botany!

Although I may perhaps be blamed for saying it, I think he did right; but, if your Director is embarrassed in any way in carrying out the class of studies which this citizen wants to have carried out, I shall think that this library has been sent to the wrong place. I do not think, however, your Director will be cramped in any way. I have no question that some of the students under your Director will lead the study of plants along new lines, and in that way make substantial contributions to this most important branch of applied science.

In the next place, let me ask, where can timber trees be better studied than here? Where can fibres and tans and a hundred practical things be investigated to better advan-

tage than here? Where can the improvement of all classes of useful plants be better undertaken than here, in the State of Missouri? You will find, if you glance over the whole field, that you have simply to use the appliances which the Shaw income can place within the grasp of your Director, to add largely to the sum of human knowledge and advance the soundest interests of the race.

Therefore I insist upon it, gentlemen, that this Institution occupies a unique position. It is attached firmly to a sound University that is sure to give it good educational guidance, and to insure the best utilization of its discipline. The Chancellor of your University, a practical man and successful educator, is bound to make every department efficient, and in this prominent, important department he has an excellent coadjutor. The Director is a practical man. There will be no wild schemes started or carried out under him. His plans are and will be well matured. I urge you to co-operate with him in every way.

You must permit me now to say that I make these suggestions, not on account of any complaint which he has made. On the contrary, he has told me that he has been left reasonably free in all directions, but I know there may come a time in the administration of every trust when it may seem wise to restrict expenditure in many ways, and sharply economize. I think in all such matters and at all times, the one who has these interests most constantly before him, and who has most at stake, namely, the Director, to whom you intrust the administration, should have much to say.

I am afraid you may think from the tenor of my remarks, that I have ignored the interesting and important relations which exist between the Shaw establishment and the St. Louis public. I should like therefore to express my hearty appreciation of the wisdom and farsightedness shown by Henry Shaw in the organization of this Garden, and the founding of Tower Grove Park, as a place for the public. In these days when there is such a mad rush from the coun-

try to the city, each municipality ought to possess extensive open fields, not merely as breathing-places for the poor, but to afford to the exiles from the country, fresh glimpses of the beautiful serenity and charm of the country world which they have voluntarily abandoned. It was the noblest sort of socialism which led Henry Shaw to present these gifts of fresh air and green leaves to his fellow citizens of St. Louis.

Now I close as I began, by tendering the heartiest congratulations on the part of my associates and myself, on account of this rapid development, which has not been too rapid, and on account of this symmetrical development, which has indeed kept everything well balanced. We offer in a spirit of pride for American science our sincerest congratulations for the present and the past, and our best wishes for the future.

It is more than a quarter of a century since I paid my last visit to St. Louis. The complete transformation which has taken place within your city limits during that time, renders it impossible to predict what any visitor to your city will see twenty-five years from now. The cordiality of your present reception makes me look forward with pleasurable anticipations to my next visit then.

Professor Goodale was followed by Professor Asaph Hall, of the Naval Observatory; General J. W. Noble, late Secretary of the Interior; Professor T. C. Chamberlin, head of the Geological Department of the University of Chicago, and late President of the University of Wisconsin; Professor T. C. Mendenhall, Superintendent of the United States Coast Survey; Dr. C. O. Whitman, head of the Biological Department of the University of Chicago and Director of the Marine Biological Labaratory at Wood's Holl; Dr. H. T. Eddy, President of the Rose Polytechnic Institute, and Chancellor W. S. Chaplin, of Washington University, who made short speeches, appropriate to the occasion.

SCIENTIFIC PAPERS.

A STUDY OF THE VENATION OF THE SPECIES OF SALIX DESCRIBED IN GRAY'S MANUAL, WITH REFERENCE TO THEIR DETERMINATION.

BY N. M. GLATFELTER, M. D.

Introduction.

I am not aware that any attempt has been made, heretofore, at distinguishing the species of Salix by their veining alone. That the accomplishment of this object is desirable will readily be granted. We distinguish the faces of individuals, or family characteristics, without being able, easily, to point out the particulars causing the different impressions. An experienced eye will distinguish even at a distance, an oak, an elm, or a cherry tree, or one kind of oak from another, by its form as produced by the special mode, in each case, of the distribution of the branches. It is believed that a careful study of the venation of willows will be a means, at least equally decisive in arriving at results; for the differences in their venation, though on a smaller scale, are, I think, equally striking. Should the following descriptions not always be sufficiently clear and definite, there will still remain the impression produced in each particular case, upon the force of which I would insist.

A glance at the accompanying plates will show the wide variety of venation. That no difficulties present themselves, by this method, is not claimed. At two or three points where certain species approach each other with extreme closeness, the determination dependent wholly upon the method, might, in single instances, fail, even in the hands of an expert. For, besides this similarity between certain species, there is often considerable variation in the

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IPOMOEA PANICULATA.

same species, especially if age is not regarded. The method is, therefore, not submitted as altogether complete in itself, but as supplemental, and, it is hoped, a useful aid to the usual technical descriptions of the species in the works on the subject.

With regard to the variation referred to above, it is chiefly dependent upon the age of the leaf, but partly also upon the season. Leaves early in the season, though of full size, generally lack character, that is certain characteristic features are not well developed. Thin-veined leaves, as might be expected, show obliteration sooner than their opposites.

It was not easy to find a basis upon which any sort of grouping might be founded. The best that seemed feasible was by taking the character of the *secondaries* as a guide. Inasmuch as the *primaries* are regular almost without exception, they would not serve the purpose. I found that if the secondaries be regular, there will be the impression of regular veining; and that the more irregular they are, the greater the impression of irregularity.

Building upon this basis I was enabled to put the included species into three fairly well defined groups. The first, comprising regular veined leaves, embraces S. alba, S. fragilis, S. lucida, S. phylicifolia, and S. argyrocarpa. The second, exhibiting partly irregular veining, consists of those species in which the secondaries, though often quite regular, sometimes lapse into marked irregularity. This group embraces S. nigra, S. amygdaloides, S. adenophylla, S. discolor, S. cordata, S. sericea, S. petiolaris, S. myrtilloides, and S. candida. Lastly, the third group comprises those species which have their secondaries almost invariably irregular, resulting in an impression of great and general irregularity of veining. In this group come S. humilis, S. tristis, S. rostrata, S. glaucophylla, S. balsamifera, S. purpurea, S. Babylonica, S. longifolia, S. herbacea, and S. Uva Ursi. S. viminalis, at the suggestion of the distinguished salicologist, M. S. Bebb, Esq., was left off of the list.

Besides the foregoing grouping, the species have been arranged as nearly as possible (it is believed with some degree of success) in the order of their resemblances. We may then distinguish sub-groups such as the following: *a*, S. alba, fragilis and lucida; *b*, phylicifolia and argyrocarpa; *c*, nigra and amygdaloides; *d*, adenophylla, discolor, cordata, petiolaris, sericea, myrtilloides, and, more distantly, candida; *e*, humilis and tristis; *f*, rostrata, glaucophylla, and balsamifera. Each of the remaining species, viz.: S. purpurea, Babylonica, longifolia, herbacea, and Uva Ursi, may be regarded as unique.

The illustrations are direct photographic copies from the natural leaves by means of transmitted light, reproduced in print by the artotypist. In spite of a reasonable amount of patience and effort it will be noticed there are considerable defects. The inherent difficulties in rendering some of the leaves were too great to be overcome. In selecting leaves for the plates from samples, regard was shown for those which should best exhibit the principal venation characteristics, although others might promise better results as to mechanical execution, or make finer pictures, or even present a more characteristic outline.

The reader is cautioned against supposing the representations to present complete and perfect pictures of what may be seen by transmitted light in the natural leaves. The very minute details, which all help to make up the impression, are, generally, more or less wanting. Even though at the first, the print was quite complete as to minutiae, something of its definiteness was lost at every step of the successive manipulations; so that wherever the natural leaf is available, it is to be regarded as far preferable for study. In reference to the terms employed in the descriptions, need was felt for some not ordinarily used in botanical descriptions. As definite a meaning as possible was given to each one used, and such meaning assigned to each as will be found defined in the accompanying glossary. The terms "loop" and "arch," so much used, were found

very convenient, and no other more suitable substitutes could be thought of.

I desire here to make general acknowledgment of my great obligation to all my correspondents who so kindly forwarded to me, at request, the fresh material needed for my work. Credit is given to each one respectively in the synopsis.

Glossary.

Primaries and secondaries, as generally used.

Tertiaries, the veinlets next after secondaries, used in subdividing.

Costals, the short or incomplete primaries.

Terminals, the delicate veining within the final meshes.

Comb-like terminals, clusters of straight terminals along midrib impinging at right angles to it; examples, Nos. 9, 11, 15.

Marginal line, a straight continuous vein along the margin; examples, Nos. 6, 21, 22.

Crenated, as generally used.

Looping, a primary bending at the border until it meets the next above it; example, No. 13.

Arching, the contiguous arms of two dividing primaries uniting; ex. No. 15.

Vanishing, as when terminals fade gradually until imperceptible.

Stellate points, seen in the center of meshes after obliteration of terminals; ex. No. 7.

Regular, when the veins run parallel, whether straight or curved; ex. No. 1.

Irregular, when parallelism is mostly absent.

Even, of unvarying caliber; ex. No. 3.

Uneven, the opposite of even; ex. No. 16.

Smooth, having clearly defined, even edges; ex. No. 3.

Blocky, when the meshes are mostly four-sided, squarish or oblong; ex. No. 8.

Polygonal, when the meshes are not blocky, but rounded, few to many-sided; ex. No. 16.

Synopsis.

Group I.— Secondaries regular.

1. S. ALBA, L.— Primaries numerous, close, straight, high-ascending, mostly extending to margin without dividing or branching, forming but a few acute loops towards the apex. Costals intervening, seldom more than one well-developed, often none. Secondaries close, straight, even, conspicuously regular with the exception of a rather frequent forking or imitation of the letter Y. Tertiaries very irregular, uneven, and, as usually observed, forming incomplete meshes owing to partial early obliteration. Except in very young leaves the impression made is therefore of quite regular veining throughout. It is the typical leaf of regularity.— Plate 1, fig. 1.

Illustration is from var. *vitellina*, Koch. The leaves of the typical form of *S. alba* examined showed greater irregularity.

2. S. FRAGILIS, L. — With slight modification the description of *alba* applies to this throughout. The looping is usually more decided, the loops less acute, and there is more curving of the secondaries, and especially of the costals. There is perhaps greater disposition to irregularity. The veins of both are brilliant as they traverse the dense green of the leaf. Of all the species in my list there is, in this pair, the nearest approach to sameness. Since, however, the external characters are different, no difficulty will arise in distinguishing them from each other. *S. lucida*, also, has a near resemblance to both. — Plate 1, fig. 2.

Illustration from vicinity (cult.).

3. S. LUCIDA, Muhl. — Primaries close, regular, curved-ascending, forming towards the apex roundish not very pronounced loops; intervening costals seldom more than one, or none. Secondaries regular, close, curving, often forking or having the Y shape. Tertiaries form irreg-

ular, acute-angular meshes, but are soon partly obliterated. The veining, as a whole, is thin, remarkably smooth and even, very brilliant by transmitted light. — Plate 1, fig. 3.

Illustration from vicinity (cult.).

4. S. PHYLICIFOLIA, L. — Primaries strong, distant, curved-ascending fully to margin, and seldom looping; if so, loops will be weak and close to margin. Costals one to several. Secondaries and tertiaries rather regular, curvy; the latter forming large meshes embracing strong terminals which disappear early; comb-terminals along midrib, seen only in young leaves. Secondaries have the Y fork frequent.

The veining as a whole is somewhat strong, zigzag or wavy, uneven, thickened at junctions. There is absence of sharp angularity. Compare this with *lucida* to note how general sameness of plan with variation of detail results in a markedly different impression produced upon the eye.— Plate 1, fig. 4.

Illustration from specimens from the Arnold Arboretum, originally from Mt. Washington, furnished by Edwin Faxon, Esq.

5. S. ARGYROCARPA, Anders.— Primaries close, zigzag, quite regular, forming from base to tip a more or less regular series of parallel, blunt loops, having seldom any costals intervening. Secondaries usually regular. Tertiaries, merging into terminals, gnarled, not forming definite meshes (in young leaves faint arborescent terminals seen in the background), cause an impression of large reticulation. Along margin some crenate veining.

As a whole the lines of veining appear crooked or wavy, and, though classed as regular, the impression is decidedly different from that of *S. alba*.— Plate 1, fig. 5.

Illustration from specimens from the Arnold Arboretum, originally from Mt. Washington, furnished by Edwin Faxon, Esq.

Group II.— Secondaries partly irregular.

6. S. NIGRA, Marsh. — Primaries distant, straight, or curved-ascending, forming acute loops in lower portion, united at the border by a marginal line in upper; prominent as compared with the rest of the veining. Intervening costals one to several, often extending to marginal line. Secondaries not readily distinguished from the tertiaries, not close, nor generally regular. Tertiaries delicate, forming very minute angular, irregular, definite reticulation. Within each mesh a single very slightly branching stem is seen.

The venation of this leaf is uniformly even, smooth, brilliant, clear, and surpasses all others in the minuteness of its reticulation. At full maturity, the meshes become vacant, retaining, occasionally, simply a stellate point.— Plate 1, fig. 6.

Illustration from specimen of vicinity.

7. S. AMYGDALOIDES, Anders. — The veining of this leaf is best described by comparison with *S. nigra*, to which it bears a very close resemblance. The primaries are closer, having but one or two intervening costals. In the lower half they extend quite to the margin, not forming loops. In the upper half looping is present, gradually merging at the tip into a marginal line. Secondaries stronger, standing out clearly from the tertiaries, mostly regular, closer, straight. Tertiaries, of equal caliber as in *nigra*, usually form a very regular net-work, resulting in larger, squarish, blocky meshes. At maturity there are visible many stellate points in the centers of meshes, — an almost exclusive characteristic pertaining to this leaf. The veining, as in *nigra*, is even, smooth, whitish, brilliant. — Plate 1, fig. 7. Stipule on Pl. 2, fig. 25.

Illustrations from specimen of vicinity.

8. S. ADENOPHYLLA, Hook.— Primaries strong, somewhat distant, simple, or dividing, forming towards the apex

some looping or arching; intervening costals several, short, inconspicuous, curving down to join the preceding primary. Secondaries relatively much weaker, usually quite regular, though with marked exceptions. Tertiaries thin, regular, forming rectangular, blocky, small meshes with scant terminals, or in mature leaf with, simply, occasional stellate points. The forms of the meshes correspond nearly with the different forms of *cordata*, being, however, generally more regular or smaller. The terminals curl so far as the thick texture permits.

Veining, as a whole, is slightly zigzag, somewhat uneven; weak with the exception of the primaries and a few of the secondaries; extends close up to the midrib. The up-curving and parallelism of the secondaries, as in *cordata*, is generally well marked. Veining at apex is *cordata*-like.—Plate 2, fig. 8.

Illustration from specimens furnished by Prof. E. J. Hill, Englewood, Illinois.

9. S. DISCOLOR, Muhl.—Primaries rather distant, curved-ascending, dividing, forming a regular series of arches and sending a strong vein into each tooth. The intervening costals curve down, ranging themselves with the secondaries to meet the primaries. Secondaries regular in part, in which case they are close; frequently quite irregular, broken, more or less zigzag. Tertiaries strong, forming medium-sized meshes in which there is abundant terminal branching. Comb-like terminals along midrib. Obliteration slow. Veining as a whole strong. —Plate 2, fig. 9.

Illustration is from specimens from Lauderdale, Wis., furnished by M. S. Bebb, Esq. Examined also specimens from the vicinity of Ithaca, N. Y., furnished by Prof. L. H. Bailey, Cornell University.

10. S. CORDATA, Muhl.— Primaries, in broad leaves, incline to the horizontal, dividing, the arms forming arches, while tipwards regular loops with round or roundish ends are seen; in narrow forms, looping often prevails throughout; intervals contain one or more costals. Secondaries

mostly regular, strong, usually close, sometimes having the Y fork. Tertiaries strong, regular when subtending regular secondaries, otherwise very irregular, forming meshes of medium size, definite, inclosing distinct, moderately branching terminals, except in young leaves where curling, vanishing terminals may be observed, as in *glaucophylla*. The meshes, therefore, sometimes irregular, angular, but generally oblong, blocky.

As a whole, the venation is zigzag, or broken, thickened at junctions, uneven, exceptionally strong, and no part early obliterated. A character noticeable in several other species, notably in *adenophylla* and *petiolaris*, but specially marked in this, is, secondaries arching upwards in parallel lines.—Plate 2, fig. 10.

S. cordata is a central, typical form, around which cluster *petiolaris*, *sericea*, *discolor*, *adenophylla*, and more distantly, *candida*.

11. S. SERICEA, Marsh. — Primaries strong, distant, curved-ascending, forming often very regular roundish loops throughout. Secondaries sometimes regular, otherwise much broken, weak. Tertiaries not much developed; when present, forming angular, polygonal, medium or small meshes, within which the very delicate flowing terminals are to be observed. Along midrib narrow, deep-green lines, and just outside of these, comb-terminals are to be seen, more or less developed.

With the exception of primaries, the veining is weak. In some forms it is not easy to distinguish from *S. cordata*. Generally, however, the veining has less strength, especially the tertiaries; terminals are more delicate, more profuse, straightening on the borders of large ribs, which is not the case in *cordata;* looping is more regular. While the veining is more irregular, it is in gentler or more graceful lines. — Plate 2, fig. 11.

Illustration from specimens furnished by Prof. L. H. Bailey, of Ithaca, N. Y. Examined specimens also from vicinity of St. Louis.

12. S. PETIOLARIS, Smith.— Resembles *sericea*. Primaries straighter and more ascending; loops less rounded, sometimes very regular. Secondaries closer. Reticulation smaller, more definite, the delicate terminals wanting or only dimly seen in the background, curled.

As a whole, the veining is stronger, especially the tertiaries, and, as in *sericea*, often very irregular. While on the one hand it resembles the latter, on the other, the more regular veined leaves bear a strong resemblance to *cordata*. There is crenate veining along the border.— Plate 2, fig. 12.

Illustration from specimens furnished by M. S. Bebb.

13. S. CANDIDA, Willd. — Primaries numerous, close, straightish but zigzag, forming a very regular series of bluntish or rounded loops well away from the margin, with crenated veining along the border. Intervening costals only occasionally present. Secondaries mostly regular, or nearly so, close, weak. Tertiaries little developed, weak, meshes therefore indefinite; when complete, they are mostly square or oblong, small. Terminals straight. Deep-green borders to midrib as well as along the large veins. Stellate points a few. The veining, excepting primaries, is even throughout. Not closely related to any other.— Plate 2, fig. 13.

The illustration is from vicinity of Lauderdale, Wis. Specimens furnished by M. S. Bebb, Esq. Owing to the peculiar character of the leaf, and, in consequence, the extreme difficulty of rendering it, the representation is a very poor one.

14. S. MYRTILLOIDES, L.— Primaries in smaller leaves close, straight, parallel, forming a very regular series, from base to apex, of rounded firm loops; in larger leaves, curved-ascending, dividing, forming arches; in both, as in *glaucophylla*, there is superimposed a second set of arches, succeeded on their outside along the border by crenate veining,— the best representation of this last character in our list. Costals one or two at intervals. Secondaries about half regular; if regular, close. Both primaries and secondaries strong. Tertiaries irregular, diminishing

from a strong beginning and gradually merging into terminals, forming indefinite, generally large meshes. Terminals, in young leaves, are exceptionally developed, arborescent, curling.

The veining as a whole is nearly even, somewhat zigzag, whitish brilliant. Resembling *glaucophylla* closely, but may be distinguished by the crenate venation, by the extreme regularity of the looping even to the very tip, by the more abundant secondaries, and by the stronger, more enduring terminals.— Plate 1, fig. 14.

Illustration from specimens supplied by Edwin Faxon, Esq., Boston, Mass. Examined specimens from Lauderdale, Wis., by M. S. Bebb, Esq., and herbarium specimens in Missouri Botanical Garden, from different places.

Group III.— Secondaries irregular.

15. S. HUMILIS, Marsh.—Primaries distant, dividing or branching, the arms forming loops, or, most frequently, arches; costals usually several. Secondaries very irregular. The tertiaries, well defined and strong, subdivide the space into large, irregular meshes which inclose remarkably well developed non-curling terminals. Comb-terminals present in young leaves.

As a whole, the venation is exceptionally strong, abundant, in broken, angular, zigzag lines,— the best type of irregular veining in our list.— Plate 3, fig. 15.

Illustration from specimen of vicinity of St. Louis.

16. S. TRISTIS, Ait.— Primaries distant, rather irregular, very zigzag, sometimes dividing, arms forming very wide arches. Secondaries usually irregular. Tertiaries, with exceptions, undeveloped, meshes indefinite or large, embracing faint, fading terminals. The veining, as a whole, very irregular, very uneven and thickened at junctions. In spite of the irregularity there is not usually a sharp angularity in the meshes; they are mostly rounded or polygonal.

Though resembling *S. humilis* in general, the impression made is quite different, chiefly owing to lack of the fine terminals of the latter. There is also absence of comb-like terminals. The veining is much weaker and earlier obliterated. This, with *rostrata* and *purpurea*, are the only ones in which a disposition to irregularity of the primaries obtains.—Plate 3, fig. 16.

Illustration from specimens furnished by Mr. J. Franklin Collins, Providence, R. I. Rendering difficult.

17. S. ROSTRATA, Richardson.— Primaries few, distant, crooked, not parallel, often dividing near their origin, and usually sending a strong vein to each tooth, strong and prominent relatively to the rest of the veining; looping irregular and wanting tipwards; intervening costals numerous, having the same general direction. Secondaries weak, scarcely stronger than the tertiaries, mostly irregular, also markedly zigzag. Tertiaries weak but well defined, forming medium-sized oblong or longish, nearly vacant (in mature leaf) meshes. There remains a background of obscured very delicate terminals. Taking a general survey of the leaf, the minute veining is seen often to assume a crescentic form.

As a whole, the veining is not, as might be expected in such a leaf, very uneven. Compare for example *S. tristis*. Absence of looping at tip causes it to be an exception to an almost universal characteristic.—Plate 3, fig. 17.

Illustration from specimens furnished by M. S. Bebb.

18. S. GLAUCOPHYLLA, Bebb.—Primaries tend to the horizontal in wide leaves, dividing well away from the margin, the arms forming a regular series of arches. There exists besides, usually, a second, smaller set of arches outside the first. Intervening costals usually but one. Secondaries few, seldom regular, changing direction abruptly, broken or zigzag. Tertiaries prominent, constituting most of the veining, very irregular, forming large, polygonal, defined meshes which in mature leaves do not embrace any terminals, save, occasionally, a stellate point.

In very young leaves extremely delicate terminals, finely branching and curling, may be observed.

As a whole, the venation is weak, very irregular, but even and smooth.— Plate 3, fig. 18.

Illustration from herbarium specimen. Fresh leaves, sent by Mr. Bebb, said to be typical, have sub-cordate bases.

19. S. BALSAMIFERA, Barratt. — Primaries strong, nearly horizontal, dividing or branching, forming arches rather irregularly. Costals one or several between two contiguous primaries. Secondaries rather distant, weak, mostly irregular. Tertiaries delicate, dividing a space into irregular, angular or blocky meshes embracing the very delicate, abundant vanishing terminals.

As a whole, the veining is irregular, broken, zigzag, but even and smooth. For so broad a leaf the primaries are uncommonly zigzag. Compared with *glaucophylla*, which it resembles, the veining is weak, with meshes smaller and more permanent. The straightness and angularity of the former is softened in this by the introduction of gentle curves and flowing terminals, giving on the whole a quite different picture.— Plate 3, fig. 19.

Illustration from specimens from the Arnold Arboretum, originally from the White Mts., supplied by Edwin Faxon, Esq.

20. S. PURPUREA, L. — Primaries distant, straight-ascending, somewhat irregular, often dividing or branching; looping not well defined; along margin irregular crenate veining. Secondaries very irregular. Tertiaries defined only in very young leaves, embracing extremely delicate faint terminals,— therefore, in mature leaves, meshes appear large, and veining scant.

On the whole, the venation is weak, even, smooth, flowing or curvy, exhibiting brilliant lines of light, winding amidst the dense green. Peculiar. Impression exceedingly distinct. — Plate 3, fig. 20.

Illustration from specimen from vicinity (cult.).

21. S. BABYLONICA, Tourn.— Primaries regular, straight-

ish until near the border, where ascension is rapid to join the next above, making an acute loop — a more or less straight marginal line resulting from this mode of junction. Secondaries mostly very irregular. Tertiaries strong, forming large meshes mostly polygonal, embracing in young leaves peculiar gnarled terminals which, by obliteration, gradually fade, or, occasionally, leave a central stellate point.— Plate 2, fig. 21.

Veining as a whole uneven as to caliber, broken, brilliant. The impression on the eye is quite peculiar,— say Oriental or Chinese,— where it is said to be native.

22. S. LONGIFOLIA, Muhl.— Primaries strong, distant, straight-ascending to a straight, firm marginal line extending from base to tip. Intervening costals several, often looping more or less completely inwards from the marginal line. Secondaries close, parallel, partially obscured, uneven, forming therefore very indefinite meshes. Tertiaries wanting. The meshes are all longish, blunt at ends, horizontal or ascending, — the long diameters all extending in the one direction.

There is no proper reticulated venation corresponding to anything as seen in other willows. In young leaves, very faint terminals, filling up the background, may be seen. Obliteration early, of all but the principals. Green lines along midrib very distinctly defined. Teeth seldom supplied by any visible veins, — a unique exception to all the rest; in young plants, however, with pinnatifid leaves, the usual rule prevails. As a whole, the veining of this leaf is extremely exceptional.— Plate 3, fig. 22.

Illustration from specimen from vicinity.

23. S. HERBACEA, L.— Primaries straight, even, high-ascending, partially palmate, dividing and sub-dividing on to the margin. Secondaries scarcely distinguishable from the tertiaries, both irregular, forming medium-sized sharply angular meshes.— Plate 1, fig. 23.

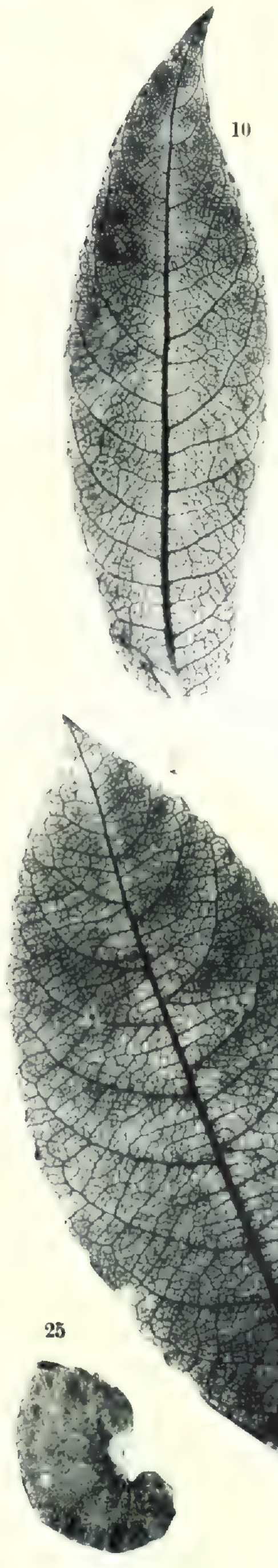
Illustration from Herbarium specimen collected on Mt.

Washington, by Edwin Faxon, and supplied by M. S. Bebb, Esq.

24. S. Uva Ursi, Pursh.— Primaries regular, straight, even, strong, forming a very regular series of rounded loops. Secondaries strong, even, usually irregular, forming large meshes inclosing quite conspicuous terminal branching. Tertiaries wanting.—Plate 3, fig. 24.

Illustration from specimens from the Arnold Arboretum, originally from Mt. Washington, supplied by Edwin Faxon, Esq.

VENATION OF SALIX.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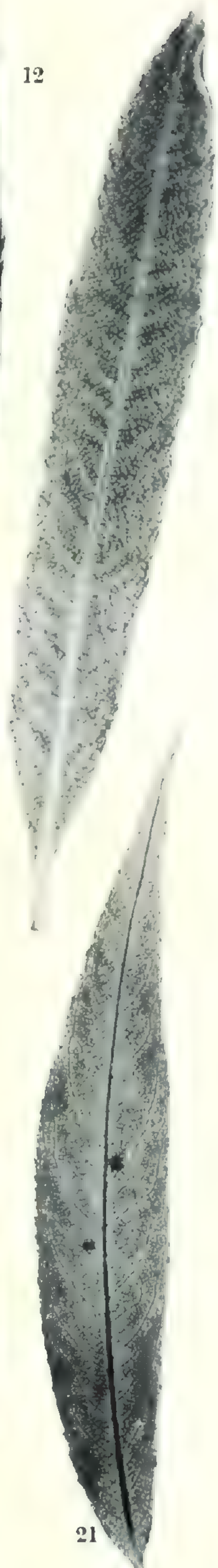
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VENATION OF SALIX.

VENATION OF SALIX.

MATERIAL FOR A MONOGRAPH ON THE TANNOIDS, WITH SPECIAL REFERENCE TO VEGETABLE PHYSIOLOGY.

BY J. CHRISTIAN BAY.

In the Transactions of the Academy of Science of St. Louis, Volume vi, No. 6, was published my material for a monograph on inuline. This paper, the second of a series of similar bibliographical contributions that I contemplate bringing together, deals with the tannoids, long known as a very important constituent of the cells of many plants. As this bibliography is particularly written from the standpoint of vegetable physiology, much of the purely chemical and technical literature has not been taken into account, though the list is intended to be complete, with this exception, up to the end of 1890. Most of the references in these papers were collected in 1891, but for certain reasons I have been unable to print any of the papers until the present time. Meanwhile, several important papers have been published by Brämer, Nickel, and Reinitzer, directing the investigation of the tannoids into a new course, and showing the imperfections of many of the so-called biological investigations.

No excuse is needed for the publication of bibliographies of this character, other than is afforded by the papers referred to. In vegetable physiology, as in all other branches of the exact sciences, every experiment must be taken into account, although conclusions and theories undergo constant changes; and the reference to such experiments is very difficult without collected bibliographies dealing with each subject.

Although the present list of papers is thought to be nearly complete, small omissions have probably crept in, and those who know from experience how difficult it is to bring together references to the literature of any special

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subject will, it is hoped, pardon these, and I shall appreciate any additions that can be brought to my notice. To my friend Mr. George Neumann, of Copenhagen, I am very much indebted for friendly assistance.

Aside from a few self-explanatory contractions, the principal abbreviations made use of are the following:—

A. or L. A. = Liebig's Annalen der Chemie und Pharmacie. Since 1832.

Ann. de chim. = Annales de chimie. 96 voll. 1789–1815.

Ann. de chim. et phys. = Annales de chimie et de physique. Since 1816.

Ann. sci. nat. = Annales des sciences naturelles. Botanique. Since 1824.

Arch. der Pharm. = Archiv der Pharmacie.

B. Z. = Botanische Zeitung. Since 1843.

Berichte = Berichte der deutschen chemischen Gesellschaft.

Berichte d. b. G. = Berichte der deutschen botanischen Gesellschaft.

Bot. Centralbl. = Botanisches Centralblatt. Since 1880.

Bull. soc. chim. = Bulletin de la société de chimie de Paris.

C. R. = Comptes Rendus hebdomadaires des séances de l'Académie des Sciences. Paris.

J. pr. Ch. = Journal für praktische Chemie. Since 1834.

Journ. Linn. Soc. = Journal of the Linnean Society. Botany. Since 1857.

Journ. de pharm. = Journal de pharmacie. Paris. Since 1815.

P. T. = Philosophical Transactions of the Royal Society of London.

Pringsh. Jahrb. = Pringsheim's Jahrbücher für wissenschaftliche Botanik. Since 1859.

Sitz. Wien. = Sitzungsberichte der k. k. Akademie der Wissenschaften, naturwiss.- mathem. Classe. Wien.

Z. anal. Ch., or Fr. Z. = Fresenius's Zeitschrift für analytische Chemie.

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THE SUGAR MAPLES, WITH A WINTER SYNOPSIS OF ALL NORTH AMERICAN MAPLES.

BY WILLIAM TRELEASE.

North American botanists generally recognize one eastern species of sugar maple with a well-marked variety, one in the Gulf States, and a third species in the mountains of the Southwest. Each of these is so variable as to weaken the lines of specific separation, and in the last treatment of the maples by an American botanist* they are all united as forms or varieties of a single species. In contrast with this conservatism, European botanists are disposed to increase the number of separable species. Pax,† in his monograph of the genus Acer, recognizes three species of his group Saccharina, comprising the eastern and southern sugar maples, while the southwestern species is maintained in his group Campestria. Wesmael,‡ in a later review of the genus, follows Pax in keeping the southwestern species apart from the group Saccharina, of which latter he recognizes only one species with two subspecies corresponding to the other two species admitted by Pax. Quite recently, von Schwerin, in an enumeration of the maples from a horticultural standpoint,§ carries the separation of forms even further than Pax, since he maintains all of the species admitted by the latter, while he recognizes three varieties and seven named forms of the northern sugar maple.

I was led by these publications to make an examination of the material in the herbarium and arboretum of the Missouri Botanical Garden and in Tower Grove Park, and

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* Sargent, Silva of North America, ii. 1891, 97.

† Engler's Bot. Jahrbücher, 1886, vii. 241, and 220.

‡ Revue critique des espèces du genre Acer.— Gand, 1890, pp. 46, 60–61.

§ Gartenflora, 1893, xlii. 455.

Reprints issued Jan. 1, 1894.

to review the principal literature of the genus Acer, in the hope of naming the forms represented. As the conclusions reached were somewhat different from those of recent writers on the genus, I have taken occasion to see the contents of the principal herbaria of the country,* and the results of my study are presented here as showing at least the range of the forms and the great variability of the eastern sugar maples.

It is now commonly understood that the name *Acer saccharinum*, which the common sugar maple has borne until quite recently, was in reality given by Linnaeus in his Species Plantarum (1753) to the silver maple; † and the tendency now is to restore this name to the plant it was originally applied to, notwithstanding the necessary confusion for a time attending the change. Granting the propriety and necessity of making this substitution, however, there appears to be some difference of opinion as to the names now to be adopted for the sugar maple and its forms. The oldest other name generally admitted as pertaining to this species, is *A. saccharum* of Marshall.‡ On the authority of Pax and Schwerin, the *Acer palmifolium* of Borckhausen § is the same species. Later names for the common sugar maple and the black maple are *A. barbatum*

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* My thanks are due Professor Britton of Columbia College, Dr. Coville of the United States Department of Agriculture, Dr. Mohr of Mobile, Dr. Robinson of Harvard University, and Professor Sargent of the Arnold Arboretum, for the use of the material in their care. I am also indebted to Mr. Marcus E. Jones of Salt Lake City, Dr. J. Schneck of Mt. Carmel, Mr. Trevor Kincaid of Olympia, Wash., Mr. Geo. W. Letterman of Allenton, Mo., Mr. E. M. Wilcox and Mr. W. C. Werner of Columbus, O., Mr. C. F. Wheeler of Lansing, Mich., and Mr. Thomas Howell of Arthur, Oregon, for specimens collected or contributed for my use.

† For the history of this name see Sargent, Garden and Forest, iv. 148.

‡ Arbustrum Americanum, 1785, 4.

§ Flora der oberen Grafschaft Catzenelnbogen, 1795, 109. — I am indebted to Professor Urban for a transcript, from which, however, I am not very certain that Borckhausen really meant a form of the sugar maple.

Michaux,* and *A. nigrum* Michaux, f.† If, as is now generally done, we take Walter's *Acer Carolinianum* ‡ to be the red maple, these are the only published names applicable to the eastern sugar maple, aside from the recent varietal and form names of Pax and Schwerin.

Unfortunately, some doubt applies to both of the names *saccharum* and *barbatum*. In advocating the restoration of the Linnean name *saccharinum* for the silver maple, Professor Sargent § considered it necessary to exclude Marshall's name for the sugar maple, because he believed that a name so nearly identical with *saccharinum* as is *saccharum*, could lead only to hopeless confusion, so that he proposed to take up the name *barbatum* of Michaux; and he finds support of this conclusion ‖ in the fact that Marshall's description is so indefinite as to leave one in some doubt as to what tree he really had in mind when he described his *Acer saccharum*. While the description given by Marshall is ambiguous, the green color of the flowers (contrasted presumably with red), and the flowering "in manner of the scarlet maple" (presumably referring to the subsessile or umbellate cluster as contrasted with the elongated inflorescence of the mountain and striped maples), seem to me to confirm rather than render doubtful the conclusion that he had the sugar maple in mind. There is, in fact, more doubt as to the plant intended by Michaux when he described his *Acer barbatum*, for though the name appears in most manuals of the thirty years succeeding its publication, Pursh ¶ is the only botanist of that time who seems to have done more than copy or paraphrase a description of it, until Torrey and Gray** state that they found in Barton's herbarium foliage specimens so named apparently

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* Fl. Bor. Amer. 1803, ii. 253.

† Hist. Arb. (Sylva, ed. 1), 1810, ii. 238.

‡ Flora Caroliniana, 1788, 251.

§ Garden and Forest, 1889, ii. 364.

‖ Garden and Forest, iv. 148.

¶ Fl. (1814), i. 266, — with *A. Carolinianum* as a synonym.

** Flora of North America, i. 249.

by Pursh, which they pronounce *Acer rubrum*. Nuttall * on their authority, as he states, goes so far as to declare *barbatum* "a nonentity, as it [or Pursh's conception of it] is founded upon the flowers of the sugar maple, the fruit of the red maple, and a leaf (probably) of the *Acer spicatum*." It may be added that the name *barbatum* was originally applied because of the bearding within the flowers, and not with reference to any pubescence of the lower surface of the leaves. As between the two names *saccharum* and *barbatum*, I should, therefore, choose the former as more certainly applying to the sugar maple, and because of its prior publication, and this conclusion has been reached also by Britton,† Hitchcock,‡ and Sudworth.§ If the identification of Borckhausen's *Acer palmifolium* is correct, this name in point of priority stands between *saccharum* and *barbatum*. It seems, however, to refer to the more typical form of the species, denoted by the former name, so that it does not invalidate the use which I shall propose to make of *saccharum* for the type, and of *barbatum* for a fairly characterized variety of the sugar maple to which the original description of *barbatum* applies more closely than to any other.

As the result of a careful examination of the available material, I am disposed to recognize three species of the group Saccharina, two of them represented by fairly marked varieties in addition to the typical form, — namely, *A. saccharum*, with its varieties *barbatum* and *nigrum*, *A. Floridanum*, with its variety *acuminatum*, and *A. grandidentatum*, the last named certainly aberrant.

Acer saccharum and its variety *nigrum* do not appear to

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* Sylva, ii. 88.

† Cat. Plants of New Jersey, 78.

‡ Trans. St. Louis Acad., v. 490.

§ Dept. Agriculture Report, 1892, 325. It may be of interest to note that in a French translation of Marshall's book by Lézermes (1788), the name is replaced by *saccharinum*, apparently because of the translator's feeling that the spelling of Marshall was the result of an error; a possibility which Professor Sargent also has suggested.

pass directly into one another, but the former does grade into the simpler leaved variety *barbatum*, and it is also difficult to determine whether a very few herbarium specimens go into *barbatum* or *nigrum*. Were it not for these, I should agree with Professor Bailey in treating the latter as a distinct species. All three forms have essentially the same distribution, the variety *nigrum* being apparently a little more restricted than the others, and the most western form belonging to the variety *barbatum* rather than the type.

The typical *saccharum*, which is evidently the plant of which Wangenheim * figures a leaf under the name *saccharinum*, is the variety *pseudo-platanoides* of Pax † and Schwerin.‡ The description and figure in the several editions of the Sylva of the younger Michaux leave no doubt that what is here called variety *nigrum* is the tree to which he applied *nigrum* as a specific name, and its extreme forms are well represented by Schwerin,§ who, mistaking for the true *nigrum* what I have called *barbatum*, as has been done also by many American botanists, describes them as pertaining to a new variety which he names var. *concolor* because of the green lower surface of the leaves.

Following Professor Bailey, who has clearly indicated the characters of *nigrum*,‖ I have tried to associate with the leaf characters, others drawn from the inflorescence and fruit; but in this attempt I have failed, because of insufficiency of well authenticated flowering specimens of the different forms (though I am disposed to think that good inflorescence characters may exist), and so great a variability in the size, form and divergence of the fruit wings that I am convinced of the inapplicability of this character.

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* Beytrag zur teutschen holzgerechten Forstwissenschaft, die Anpflanzung nordamericanischer Holzarten, mit Anwendung auf teutsche Forste, betreffend, 1787, pl. 11, f. 26.

† Engler's Bot. Jahrb. 1886, vii. 242.

‡ Gartenflora, xlii. 455, f. 95, no. 1.

§ *l. c.* 456, f. 95, nos. 6 and 7.

‖ Bot. Gazette, xiii. 214.

Utilizing such differences as I find, I separate the maples of the *saccharum* group as follows, admitting under each only such citations as I am reasonably sure of, and without having attempted to make the bibliography at all complete. Specimens without mature foliage have not been cited, for the reasons above given.

ACER SACCHARUM Marshall, Arbustrum (1785), 4; Newhall, Trees N. E. Amer. 150, f. 75. — *A. saccharinum* Wangenheim, Nordamer. Holzarten (1787), 26, pl. 11, f. 26; Michaux, Sylva, i. 101, pl. 42; Pursh, Fl. i. 266; Hooker, Fl. Bor.-Amer. i. 113; Torrey, Compend. 170, and Fl. N. Y. i. 136; Torrey & Gray, Fl. i. 248; Gray, Manual, ed. 1, 80, ed. 6, 117, and School and Field Book, 91; Browne, Trees, 82; Emerson Mass. ed. 2, 558, with plate; Bailey, Popular Gardening, 1887, 24, in part, with figure; and Bot. Gazette, xiii. 214, in part. — *A. barbatum* Sargent, Silva, ii. 97, pl. 90. — *A. palmifolium* var. *pseudoplatanoides* Schwerin, Gartenflora, xlii. 455, f. 95, no. 1. — *A. saccharinum* var. *pseudoplatanoides* Pax, Engler's Jahrb. vii. 242, in part; Wesmael, Acer, 61.

Bark gray; internodes mostly slender and elongated, commonly glossy and reddish; buds gray, conical, slender and acute; petioles little dilated at base, not concealing the mature buds, without stipules; leaves thin, typically large (usually 4 to 7 inches broad), flat, dull, usually light green above, the lower surface grayish, glabrous to pubescent, or exceptionally quite hirsute when young, isodiametric, truncate at base to slightly cordate with an open sinus, or broadly cuneate, rather deeply 5-lobed, except for some smaller 3-lobed leaves near the ends of the branches, with typically narrow sinuses, the three larger lobes with parallel sides or dilated upwardly and each with a slender apical acumination often sinuously bidentate on the sides, and two similar lateral acuminations, or the lateral lobes merely sinuate on the upper margin, the smaller outermost lobes mostly sinuously 1 to 2 toothed on the lower margin;

fruit large (6 × 10 mm.), the outer lines of the large wings (8 to 12 × 16 to 28 mm.) nearly parallel or spreading to something less than a right angle. — Plate 4.

Range, Nova Scotia to West Virginia, Illinois, Missouri (?), Ohio, Michigan and Canada.— Specimens examined from Nova Scotia (Macoun, 1883), Canada (Ottawa, Macoun, July 24, 1882; Termiscouta Co., Northrop, 135; Wingham, Morton, June 20, 1891), New Hampshire (M. 119 in hb. Sargent), Massachusetts (Essex Co., Pickering), New York (Torrey; Greene Co., Miss Vail, June 27, 1891 — with a second specimen which if taken alone would be referred to var. *barbatum*), Pennsylvania (Easton, Porter, July 1891; West Chester, Darlington, "the common form"), West Virginia (White Sulphur Springs, Britton, Aug. 19, 1890), Ohio (Cincinnati, Lloyd, 1890; Painesville, Werner, 1892), Illinois (French; Grand Tower, Vasey), and Michigan (Lansing, Wheeler, Oct. 1892),— Cultivated at Cambridge, 1859; Kew, Nicholson, 1880, 1342, and St. Louis, 1893.

ACER SACCHARUM var. BARBATUM (Michaux).— (*A. barbatum* Michx. Flora, ii. (1803), 252; Pursh, Flora, i. 266; Torrey, Compend. 169; Torrey & Gray, Fl. i. 249; Beck, Bot. 63; Eaton, Manual, ed. 4, 186, ed. 5, 90, ed. 6, 2, ed. 7, 140; Eat. & Wright, 112?).— *A. saccharum* var. *nigrum* Newhall, Trees N. E. Amer. 152, f. 76.— *A. barbatum* var. *nigrum* Sargent, Silva, ii. 99 in part and pl. 91. — *A. saccharinum* Bailey, *l. c.* in part.— *A. saccharinum* var. *glaucum* Pax, Engler's Jahrb. vii. 242 in part; Wesmael, Acer, 61.— *A. palmifolium* var. *nigrum* Schwerin, Gartenflora, xlii. 456, f. 95 no. 4.— *A. Rugelii* Pax, Engler's Bot. Jahrb. vii. 1886, 243; Schwerin, Gartenflora, xlii, 457. — *A. saccharinum* subsp. *Rugelii* Wesmael, Acer, 61.

Bark gray to almost black; internodes often shorter and stouter, commonly dull but reddish; buds gray, pubescent or dark, conical ovoid, often obtuse; petioles as in the last and

without stipules; leaves firm, of medium size (usually about 4 in. broad), flat, somewhat glossy and of various shades of green above, pale or glaucous and downy to glabrous beneath, mostly broader than long, cordate with shallow open basal sinus to truncate, 3-lobed with very open round sinuses (the upper margin of the lateral lobes often spreading nearly in a straight line), the lobes sinuously narrowed from the base to a single acumination, or the median lobe sometimes dilated by a pair of blunt shoulders, one or two similar dilatations also on the lower margin of each lateral lobe, and exceptionally developed into short complementary lobes; fruit as in the last.— Plates 5 and 6.

Range, Connecticut to New Jersey, Tennessee, Missouri and Michigan. — Specimens examined from Connecticut (Norwich, Lumsden, July 1, 1885), New York (Sullivan Co., Eggert, 1873; Yates Co., Buckley), New Jersey (Weehawken, Schrenk), Pennsylvania (Bedford, Soulard, Sept. 1860), Ohio (Cincinnati, Lloyd, July 14, 1882), Tennessee, (Dandridge, Rugel, July 1842, — one of the originals of *A. Rugelii;* Knoxville, Rugel, Mar. 1842, — one of the original collections of *A. Rugelii*,— Sargent, September 17, 1888; Nashville, Gattinger, September 1879, — and no. 497*of Curtiss' exsiccatae), Alabama (Walnut Creek, Mohr, July 31, 1880), Missouri (about St. Louis, Eggert, 1875 and 1877; Allenton, Letterman, various collections, one of July 1883, with the 3 lobes long, tapering and not at all sinuate, of which Mr. Letterman says "only one tree seen;" Washington Co., Letterman, August 20, 1881), Michigan (Lansing, Bailey, September 15, 1887, and Hicks, June 15, 1893; Michigamme, Trelease, July 19, 1887; Alma, Davis, May 1891). — Cultivated in Washington (Vasey, 1873), and about Boston (Sargent, July 1, 1880). A curious form with long caudate lobes, cultivated at Frankfurt am Main (Engelmann, Apr. 1826).

An examination of numerous trees about Allenton, Mo., in company with Mr. George W. Letterman, and about O'Fallon, Mo., shows that as a rule the bark of this variety

soon becomes black, retaining this color for many years, though ultimately by exfoliation it becomes gray on old trees. The characteristic foliage and twig characters are sometimes replaced by those more nearly agreeing with the type of the species, from which, on the whole, I think the variety separable. Of these intermediate forms are the following: —Canada, (Niagara Falls, Schrenk, Aug. 1888; Belleville, Macoun, 1866, 984; Pelee Point, Macoun, June 30, 1882, 985), New York (hb. Gray; Kelsea's, Schrenk, 1883), New Jersey (Sparta, Britton, Sept. 11, 1890), Pennsylvania (Bethlehem, Lochman, June 1891), Tennessee (Carter Co., Small and Heller, July 16, 1891), Illinois (Jonesboro, Wolfe, 1872; opposite St. Louis, Engelmann and Eggert, various collections; about Mt. Carmel, Schneck, numerous specimens, many of them with 5-lobed leaves with the middle lobe dilated upwards, but coriaceous, and with thick mostly blunt buds), and Missouri (Allenton, Letterman, various collections; O'Fallon, Trelease).

ACER SACCHARUM var. NIGRUM (Michaux, f.) Britton, Trans. N. Y. Acad. 1889, ix. 9; Sudworth, Rept. Secy. Agric. 1892, 325. — *A. nigrum* Michx. f., Hist. Arb. Amer. ii. 1810, 238, pl. 16, and Sylva, various editions, pl. 43; Gray, Amer. Nat. vi. 767, vii. 422; Bailey, Popular Gardening, Nov. 1887, 24, with figure, and Bot. Gazette, xiii. 214; Eaton, Manual, ed. 2, 122, ed. 4, 186, ed. 5, 90, ed. 6, 2, ed. 7, 140; Eat. & Wright, Bot. 112; Pursh, Fl. i. 266; Torrey, Compend. 170; Beck, Bot. 63; Hooker, Fl. Bor.-Amer. i. 113; Wood, Class Book, editions of 1851, 1854 and two styles of 41st ed., 213, editions of 1861, 1865, 1867 and 1868, 286, and Fl. Atl. 74. — *A. saccharinum* var. *nigrum* Gray, Manual, ed. 1, 80, and ed. 6, 117; Browne, Trees, 84, with figure; Torrey, Fl. N. Y. i. 137; Torrey & Gray, Fl. i. 248. — *A. barbatum* var. *nigrum* Sargent, Garden & Forest, iv. 148, f. 27 (stipules), and Silva, ii. 99 in part. — *A. saccharinum* var. *glaucum* Pax,

Engler's Bot. Jahrb. vii. 242 in part; Wesmael, Acer, 61. — *A. palmifolium* var. *concolor* Schwerin, Gartenflora, xlii. 457, f. 95, nos. 6 and 7.

Bark nearly black; * internodes stout, sometimes short, dull, buff; buds dark, ovoid, often obtuse; petioles dilated at base so as usually to cover the buds, with adnate triangular or oblong foliaceous stipules; leaves soft but of heavy texture, large (usually 5 to 6 in. broad), with drooping sides, dull and dark green above, clear green and usually persistently downy below, isodiametric, the larger deeply cordate with often closed sinus, 3- to 5-lobed, with shallow broad sinuses from which the lobes are undulately narrowed to an acute or acuminate point, rarely with short lateral acuminations; fruit as in the last.— Plate 7.

Range, Vermont (?) to New York, Virginia, Kentucky, Missouri and Michigan. — Specimens examined from New York, Pennsylvania (Lycoming Co., Small and Heller, Sept. 19, 1890; Westmoreland Co., Pierron, May 1, 1877), District of Columbia (Little Falls, Ward, 1877), Virginia (Smyth Co., Small, May 24 and July 9, 1892, and Britton and Vail, June 1892), West Virginia (White Sulphur Springs, Britton, Aug. 19, 1890), Kentucky (hb. Gray and hb. Chapman), Missouri (Jackson Co., Bush, Sept. 28, 1893), Ohio (Cincinnati, Lloyd, 1888; Ashtabula Co., Bogue, 1892), Indiana (Indianapolis, Britton, Aug. 23, 1890, Hitchcock, Aug. 25, 1890; Wabash, Mills, June 9, 1873), and Michigan (Lansing, Wheeler, May 1890 and June and Oct. 1891; Bailey, Sept. 15, 1887 and May 24, 1888). — Cultivated in St. Louis.

Specimens from Vermont (Pringle, 1879; Robbins) and Missouri (Allenton, Letterman, Sept. 25, 1880; Jackson

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* Rush states, in the American Philosophical Transactions, 1793, iii. 65, that sugar trees tapped by "a small woodpecker which feeds upon the sap" (the sap sucker) afterward acquire a black color and possess sweeter sap than the others, but he does not note that the same result follows tapping for sugar, and it may be inferred that he had under his observation trees of the black maple or var. *barbatum*, which, possessing sweeter sap, may prove more attractive to these birds.

Co., Bush, Sept. 27, 1893), without stipules, possess the green lower leaf surface and, in part, the general aspect of this variety, but I am doubtful whether to place them here or in the preceding variety, and the same may be said of a specimen collected at Houghton, Mich., by Engelmann in 1878.

ACER FLORIDANUM (Chapman) Pax, Engler's Jahrb. 1886, vii. 243; von Schwerin, Gartenflora, xlii. 457.—*A. saccharinum* var. *Floridanum* Chapman, Fl. So. U. S. (1860), 81.—*A. saccharinum* subsp. *Floridanum* Wesmael, Acer, 61.—*A. barbatum* var. *Floridanum* Sargent, Garden and Forest, iv. 148, and Silva, ii. 100, pl. 91.—*A. saccharum* var. *Floridanum* Sudworth, Rept. Dept. Agr. 1892, 325.

Bark dark (?); internodes very slender, elongated, mostly dull, reddish becoming gray; buds globose-ovoid, obtuse, very small for the group, gray to dark brown; petioles very slender, little if at all dilated, without stipules; leaves thin but firm, or typically thicker and coriaceous, flat, medium sized to small (usually 2 to 4 in. broad), rather dark green and glossy above, below whitened and from subglabrous to very tomentose, broader than long, truncate or shallowly and openly cordate at base, 3- to 5-lobed, with variously open sinuses, the lobes sinuously narrowed to the broad very obtuse apexes, or more or less parallel sided and 3-lobed above; fruit small (4 × 6 mm.), the outer line of the small wings (6 × 12 mm.) forming about a right angle. — Plates 8 to 10.

Range, Georgia to Florida, Mississippi, Louisiana and Arkansas. — Specimens examined from Georgia (Columbus, Curtiss, 1875), Florida (Chattahooche, Curtiss, Mar. 1880, 497*; Vasey, 1892), Alabama (Girard; Troy, Mohr, June 1880; Walnut Creek, Mohr, May 20 and July 31, 1880), Mississippi (Quitman, Mohr, May 16 and 20, 1880), and Arkansas (Fulton, Letterman, May 4, 1881). Two specimens from Louisiana (Alexandria, Hale, and Sodus, Letterman, Sept. 1883), have the leaves more acutely and

incisely lobed than usual, and green below, as in the next variety.

ACER FLORIDANUM var. ACUMINATUM.

Characters of the type, but the leaves green below, isodiametric, shallowly 3-lobed with long tapering pointed apexes. — Plate 11.

Range, North Carolina to Georgia and Alabama. — Specimens examined from North Carolina (Stanley Co., Small & Heller, Aug. 18, 1891, 381; Dr. Hunter), Georgia (Rome, Ravenel, 1871), Alabama (Choctaw Co., Mohr, Aug. 20, 1880; Walker Co., Mohr, Aug. 16, 1880; Cullman, Mohr, June 18, 1891; Mt. Sterling, Mohr, Aug. 19, 1880).

The forms of this variety and of *A. Rugelii* Pax, bring *Floridanum* and *saccharum* var. *barbatum* close together.

ACER GRANDIDENTATUM Nutt. in Torr. & Gray, Fl. i. (1838), 247; Sargent, Census Rept. 48; Pax, Engler's Jahrb. vii. 220; Wesmael, Acer, 46; Schwerin, Gartenflora, xlii. 325. — *A. barbatum* var. *grandidentatum* Sargent, Garden and Forest, iv. 148, and Silva, ii. 100, pl. 92. — *A. saccharum* var. *grandidentatum* Sudworth, Rep. Sec. Agricult. 1892, 325.

Bark gray; internodes elongated, rather stout, dark red, more or less glossy, becoming light gray the second year; buds dark reddish brown, conical, acute, the pointed scales somewhat loose at tip and lined with long white hairs; petioles rather abruptly dilated, without stipules; leaves coriaceous, medium sized (usually 3 to 4 in. broad), flat, clear green and dull above, more or less pale and velvety below, isodiametric or commonly broader than long, usually rather deeply cordate with open basal sinus, 5-lobed with open sinuses, the upper three lobes commonly dilated upwards and, like the lower margin of the outer lobes, serrately 2- to 3-lobed on each side, all of the lobes typically rather acute; fruit large (6 × 6 mm.), the outer lines of the rather large wings (10 × 20 mm.) forming a right angle, while the inner are subparallel. — Plates 12 to 13.

Range, Montana to Nevada, New Mexico, South Central Texas, and Northern Mexico. — Specimens examined from the Rocky Mountains (Nuttall), Utah (Wasatch Mts., Watson, May 1869, 214; Provost's Fork, Fremont, 1845, 305; City Creek Cañon, Engelmann, 1880, Jones, 1893, and 1880, 1437; Glenwood, Ward, 1875, 197; Parry, 1874, 29; Hooker & Gray, 1877), Nevada (Wheeler, 1872), Arizona (Ash Creek, Rothrock, 1874, 303; Huachuca Mts., Lemmon, 1882, 2650, Pringle, 1884; Sta. Catalina Mts., Lemmon, 1881, 121), New Mexico (Mogollon Mts., Greene, Apr. 25, 1881, Rusby, 1881, 69), Texas (Boerne, Sargent, Mar. 27, 1887; Guadalupe Mts., Havard), Mexico (Mt. Caracol, Palmer, Aug. 1880; San Luis Mts., Mearns, 1892, 71).

When destitute of flowers, fruit, and even foliage, during the winter season, the several species of maple occurring in the United States may usually be recognized with certainty by one who is familiar with the characters afforded by their bark, twigs, and buds; and it is hoped that the following winter synopsis, with the accompanying plates, may prove useful to botanists who wish to familiarize themselves with trees in their winter appearance, and to teachers, who will find the study of twigs in winter a very good means of developing the power of observation in pupils.

ACER. — Trees or shrubs with rather slender nearly terete twigs, somewhat four-sided minutely crenulate continuous pith, low opposite v-shaped leaf scars mostly connected by transverse lines, three evident bundle scars (or the uppermost often divided into two, and the number increased to seven or nine in *macrophyllum*), and medium sized ovoid or conical more or less stalked buds with their outer scales ending in small scars where rudimentary blades have fallen away. — The branches often end in dried remnants of the inflorescence, or in a scar when they have fallen, the terminal bud is often abortive in *circinatum*, and in the soft

maples the axillary buds are frequently accompanied by globose collateral or even superposed buds which, however, develop within the axils of the lowermost scales of the main bud, and so represent branches of the normal axillary branch, and not proper supernumerary buds.

KEY TO THE SPECIES.

* Buds evidently stalked, with few scales, these valvate in pairs so that all but the outer two are concealed: leaf scars acute margined: pith brown. — Bush Maples.

Buds large (6 to 10 mm. long exclusive of stalk), glabrous: twigs glabrous, with a more or less developed decurrent line between the nodes: bundle scars often 5 to 7....*A. Pennsylvanicum.*

Buds small (about 5 mm. long including the stalk).

Twigs and buds glabrous, the latter plump.....*A. glabrum.*

Closely gray pubescent, the buds slender.....*A. spicatum.*

* * Buds not evidently stalked, the outer pair of scales separated, hairy-tufted at apex: leaf scars acute margined, their axils more or less hairy: pith white or at length yellowish. — Vine Maples.

Twigs and buds at first pubescent with long, loose hairs, and generally viscid.....*A. circinatum.*

* * * Buds large, ovoid, the lateral appressed, not evidently stalked, but sometimes lengthening into short, leafless branches the first year: exposed scales 6, or in reduced lateral buds only 2, the lower pair fused at base: leaf scars meeting, glabrous. — Sycamore Maples.

Twigs very stout, glabrous and glaucous: pith brownish: bundle scars 7 to 9.....*A. macrophyllum.*

* * * * Buds short stalked, often appearing sessile: exposed scales 6 or more, ciliate, several pairs not meeting at apex, but the outermost pair often fused below.

+ Exposed scales 6 to 8, red or reddish, tomentose ciliate, the lowest pair commonly deciduous in early winter, exposing a collateral bud on either side: leaf scars of a given pair rarely contiguous: pith pinkish. — Soft maples.

Bark gray, falling away in large thin flakes on old trees: twigs glabrous, reddish.....*A. saccharinum.*

Bark whiter, rough on old trunks, but not flaking in large pieces.

Twigs red, glabrous .....*A. rubrum.*

Twigs tomentose above.....*A. rubrum* var. *Drummondii.*

+ + Exposed scales 8 to mostly 12 to 16, brown to nearly black, often with silky gray pubescence: no collateral buds: leaf scars acute margined, each pair almost meeting by their outer angles, their axils commonly gray or yellow pubescent. — Sugar maples.

++ Buds rather large (about 5 mm. long): twigs relatively stout.
Twigs deep red, glossy: buds conical, acute, nearly black: leaf-scars often separated .....*A. grandidentatum.*
Twigs reddish buff.
Buds conical, acute, gray pubescent: twigs mostly glossy.
.....*A. saccharum.*
Buds conical ovoid, often obtuse, usually darker: twigs mostly dull: bark of trunk mostly dark.....*A. saccharum* var. *barbatum.*
Twigs green to gray buff, dull.
Buds ovoid-conical, often very obtuse: bark of trunk black.
.....*A. saccharum* var. *nigrum.*
++ ++ Buds small (2 to 3 mm. long), globose-ovoid, usually very obtuse: twigs very slender.....*A. Floridanum.*

Group I. Bush Maples (Plate 14).

Buds evidently stalked, with valvate scales.

A. Pennsylvanicum L. (Striped Maple). — Shrub or small tree. Bark rather thin, green brown or red with narrow white longitudinal lines and often transversely warty, or at length dark gray; twigs relatively stout, glabrous except for a few brown hairs at the uppermost node, green or red, without conspicuous lenticels; leaf scars broad, with often five or seven bundle scars; buds red, glossy, 6 to 10 mm. long exclusive of the rather long stalk.— Canada to Minnesota, south to the mountains of Georgia.

A. glabrum Torrey (Dwarf Maple). — Shrub or small bushy tree. Bark thin, gray to brown, smooth; twigs glabrous, slender, mostly bright red, becoming white or gray, with few small dark inconspicuous lenticels, their epidermis flaking off in a thin silvery film after which the gray or buff and red coloration is more or less in reticulated striae; leaf scars as in the following; buds plump, often wing-margined, mostly bright red, glabrous. — British Columbia to Southern California, Colorado, Northwestern Nebraska, and the mountains of New Mexico, Arizona, and Nevada.

A. spicatum Lam. (Mountain Maple). — Shrub or small bushy tree. Bark very thin, reddish brown to dingy gray, with buff lenticels, smooth or slightly furrowed; twigs gray tomentose above, slender, greenish with one side

mostly red or purple, their lenticels few and inconspicuous; leaf scars very narrow, margined and nearly meeting; buds green or reddish, densely covered with very short appressed gray hairs. — Canada to Saskatchawan, south to Virginia, Kentucky, and the mountains of Georgia.

Group II. Vine Maples (Plate 14).

Buds nearly sessile, the outer pair of scales separated.

A. circinatum Pursh (Vine Maple). — Spreading or prostrate shrub or small tree. Bark very thin, dingy grayish-brown, generally with slightly marked or no lenticels, closely and shallowly white grooved; twigs mostly viscid and with sparse long and soft hairs, slender, greenish to red, without conspicuous lenticels; leaf scars with appressed thin border, ciliate in the axils; buds broadly conical, rather obtuse, with more or less abundant long hairs, the terminal frequently abortive and concealed by the enlarged uppermost pair of lateral buds; pith in my specimens rarely a little brownish. — British Columbia to the mountains of northern California.

Group III. Sycamore Maples (Plate 15).

Buds nearly sessile, large: exposed scales mostly 6.

A. macrophyllum Pursh (Long-leaved Maple).— Tree of medium or large size. Bark gray-brown, thick, deeply fissured, with anastomosing ridges; twigs stout, glabrous, green to purple, somewhat glaucous, with numerous small lenticels; pith brownish; leaf scars broad, contiguous, with 7 to 9 bundle scars; buds purplish, large, plump, ovoid, red or green, the lateral closely appressed.— Alaska to southern California.

Group IV. Soft Maples (Plate 15).

Buds nearly sessile, mostly red: exposed scales 6 to 8.

A. saccharinum L. — *A. dasycarpum* (Silver Maple).— Large diffusely branched tree. Bark moderately thick,

gray, on old trunks falling away in large flakes so as to expose the brown inner layers; branches smooth, gray; twigs glabrous, reddish, with scattered pale brown elongated lenticels which are crowded and very prominent on dwarf shoots; buds red or brown, the inner scales of flower buds red tomentose above on the back.—New Brunswick to Dakota, Indian Territory and Florida.

A. RUBRUM L. (Red Maple).—Large tree of more compact growth. Bark thinner, dark gray, rough but not separating in large flakes; branches smooth, gray to almost white; twigs as in the last, but with whiter lenticels; buds often nearly black.—New Brunswick and Canada to Dakota, Missouri, Eastern Texas, and the South Atlantic States. Not separable from the Silver Maple by its twigs, but easily recognized when the bark of the branches and trunk is seen.

VAR. DRUMMONDII (Hook. & Arn.) Sargent (Woolly Swamp Maple).—Large tree. Bark about as in the type, or even whiter and smoother; twigs gray, densely covered above with white wool, as are the buds.—Swamps, Georgia to the Gulf, west to Texas, and thence northwards to southeastern Missouri.

GROUP V. HARD OR SUGAR MAPLES (PLATE 16).

Buds nearly sessile, gray to brown or black: exposed scales 8 to 16.

A. GRANDIDENTATUM Nuttall (Western Hard Maple).—Small tree. Bark thin for the group, light gray, smooth or finally separating in thickish flakes about 2 in. long; twigs glabrous, dark red, with scattered very small pale lenticels, at length striate and gray; buds conical, acute, nearly black, the scales often sharp-pointed and the upper more or less silvery pubescent.—Montana to the mountains of Nevada, New Mexico, Southern Texas and Mexico.

A. SACCHARUM Marshall (Sugar Maple).—Large round-topped tree. Bark thick, gray, rough; twigs buff, more or

less tinged with orange, glossy, becoming gray, with small pale lenticels; buds conical, acute, gray pubescent.— Nova Scotia to West Virginia, west to Illinois and Canada.

Var. BARBATUM (Michx.) Trelease (Thick-leaved Sugar Maple).— Size and habit of the type. Bark mostly dark; twigs with mostly shorter internodes, reddish buff, duller; buds conical ovoid, stouter and more obtuse, often nearly black.— Connecticut to Michigan, south to Tennessee and Missouri.

Var. NIGRUM (Michx. f.) Britton (Black Maple).— Bark black; twigs gray or green buff, dull; buds ovoid, dark, mostly very obtuse.— Vermont to Virginia, Kentucky, Missouri and Michigan.

A. FLORIDANUM (Chapman) Pax (Southern Sugar Maple).— Tree of medium size. Bark dark (?); twigs glabrous, very slender, reddish becoming gray, with numerous prominent lenticels, mostly dull; buds globose ovoid, obtuse, brown to nearly black, very small for the group.— Georgia to Florida, Louisiana and Arkansas.

Var. ACUMINATUM Trelease, can not be separated in its winter condition, so far as my material shows, but it is not improbable that a study of trees in the field may reveal good winter characters.

The Box Elder, *Acer Negundo* L., now generally kept apart in the genus Negundo, has the general characters of the Sycamore Maples, but the closely appressed hairy lateral buds have only two outer scales, and the thin margined leaf scars are mostly glandular ciliate and have 3 large bundle scars. The twigs are green or purple, very glaucous in the western form, and glabrous, except occasionally near the nodes, or throughout in the southwestern plant.

EXPLANATION OF PLATES.

All of the illustrations were drawn by Miss Grace E. Johnson, under the supervision of the author.

THE SUGAR MAPLES.

Plate 4. *Acer saccharum*, typical form, natural size, with winter twig, × 3.

Plate 5.— *A. saccharum* var. *barbatum*, natural size (from a Michigan specimen), with winter twig, × 3 (from a Missouri specimen).

Plate 6.— *A. saccharum* var. *barbatum*, natural size (one of the originals of *A. Rugelii*, from Knoxville, Tenn.,— the isolated fruit and bud specimen from Rugel's Dandridge material), with bud characters, × 3.

Plate 7.— *A. saccharum* var. *nigrum*, natural size; with winter twig, × 3.

Plate 8.— *A. Floridanum*, natural size (from Curtiss' Chattahooche material).

Plate 9.— *A. Floridanum*, natural size (from Vasey's Chattahooche specimens), with bud characters, × 3 (from Letterman's Sodus material).

Plate 10.— *A. Floridanum*, natural size (from Mohr's Quitman specimens).

Plate 11.— *A. Floridanum* var. *acuminatum*, natural size (from Small and Heller's No. 381), with bud characters, × 3.

Plate 12.— *A. grandidentatum*, natural size (from Jones' material).

Plate 13.— *A. grandidentatum*, natural size (a Mexican form, from Mearns' material).

WINTER CHARACTERS OF MAPLES.

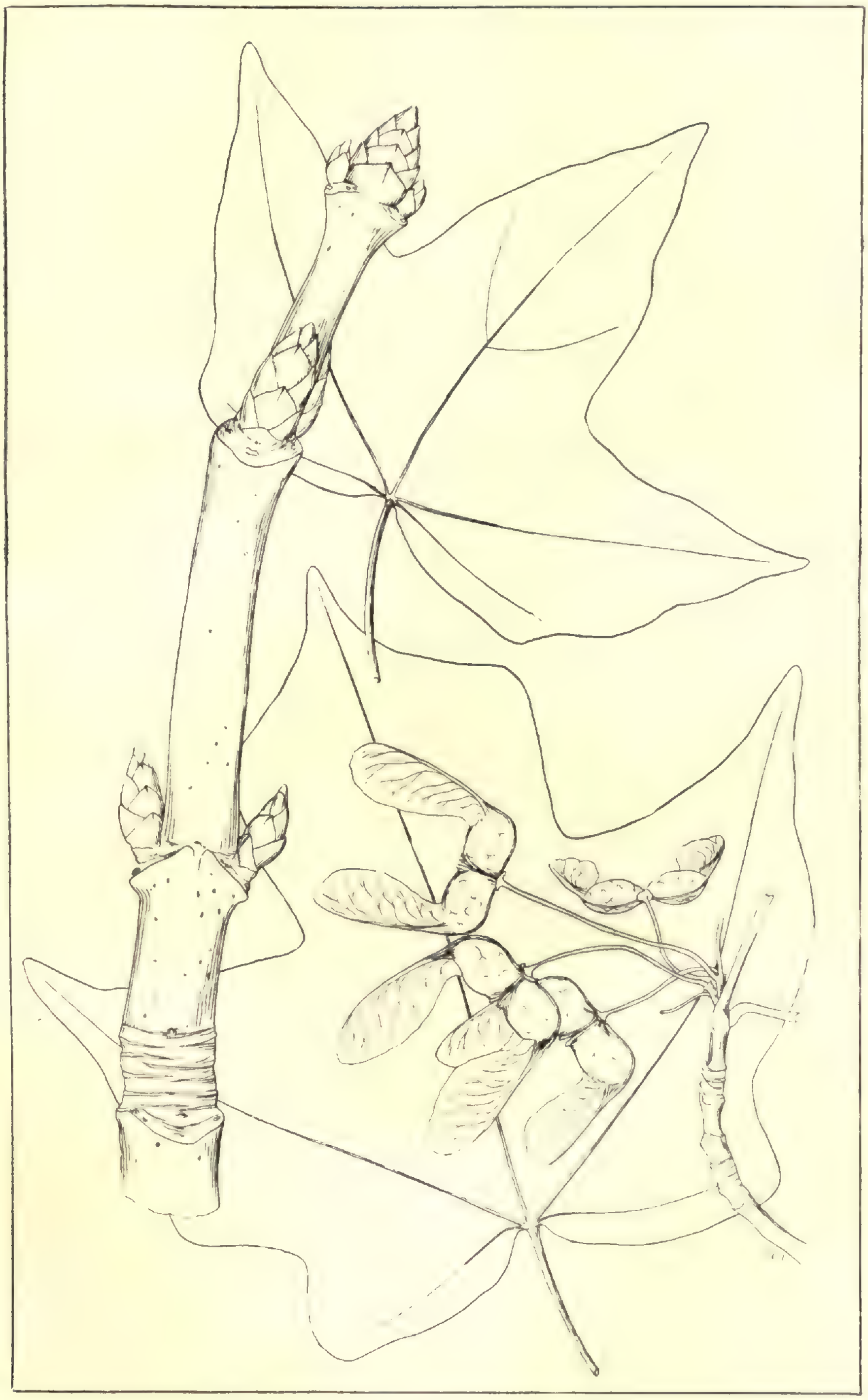
(Twigs natural size: details × 3).

Plate 14.— 1 to 3, *A. Pennsylvanicum*; 4 to 6, *A. glabrum*; 7 to 9, *A. spicatum*; 10 to 13, *A. circinatum*.

Plate 15.— 14 to 16, *A. macrophyllum*; 17 to 18, *A. saccharinum* (*dasycarpum*); 19 to 23, *A. rubrum*; 24 to 26, *A. rubrum* var. *Drummondii*.

Plate 16.— 27 to 29, *A. grandidentatum*; 30 to 32, *A. saccharum*; 33 to 34, *A. saccharum* var. *barbatum*; 35 to 36, *A. saccharum* var. *nigrum*; 37 to 38, *A. Floridanum*.

ACER SACCHARUM.



ACER SACCHARUM VAR. BARBATUM.

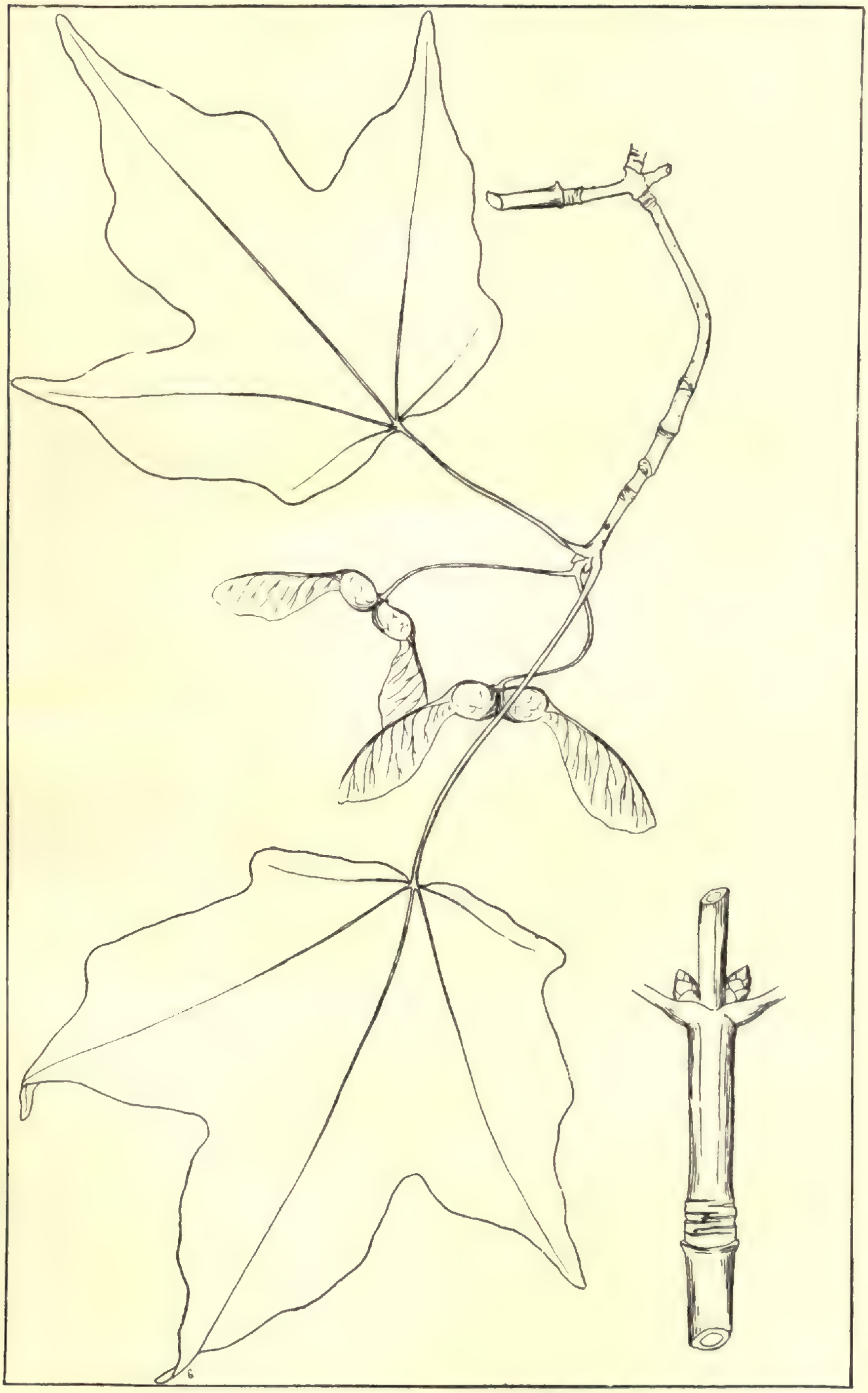
ACER SACCHARUM VAR. BARBATUM.
(A. RUGELII.)

ACER SACCHARUM VAR. NIGRUM.

ACER FLORIDANUM.

ACER FLORIDANUM.

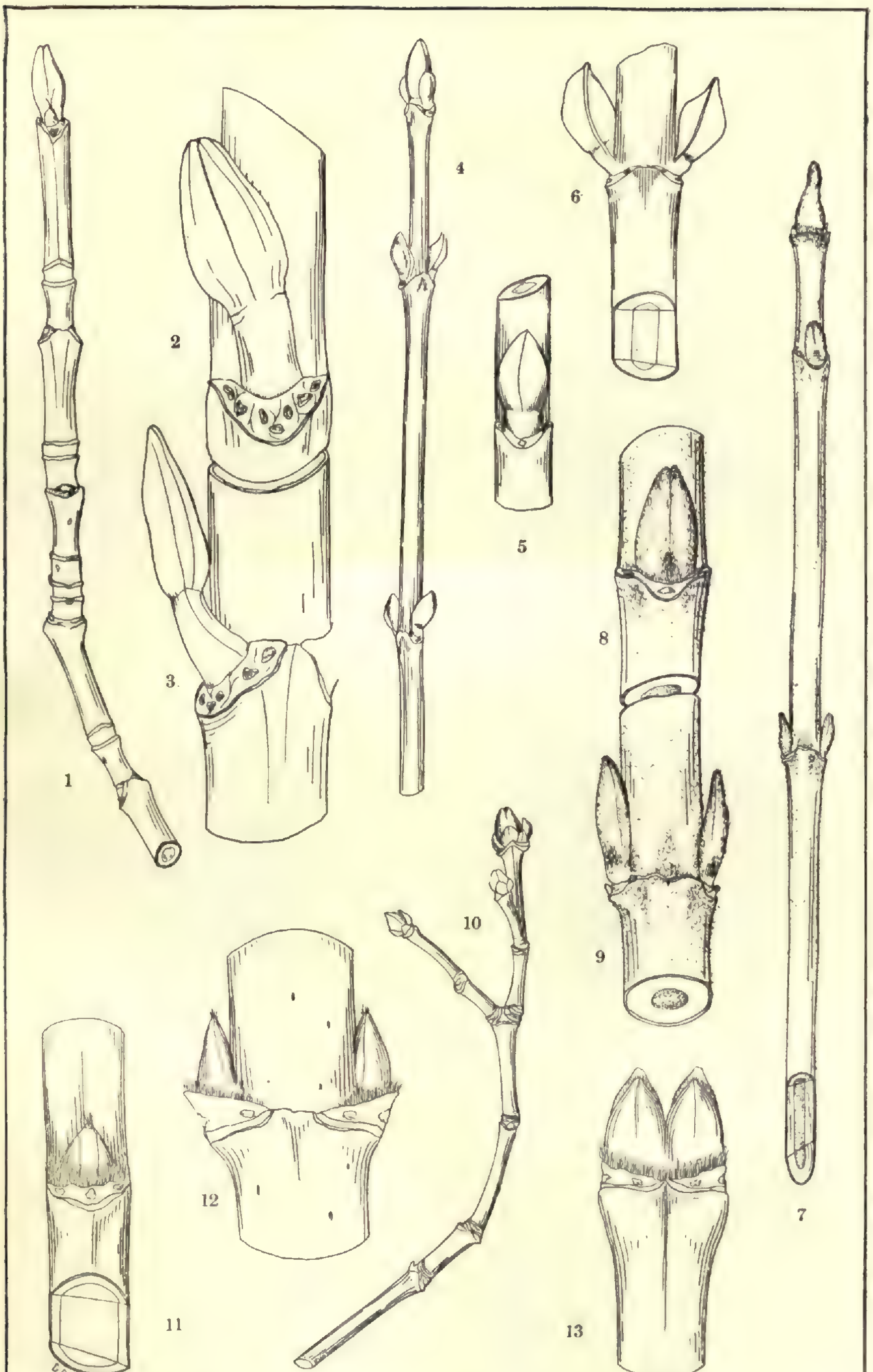
ACER FLORIDANUM.



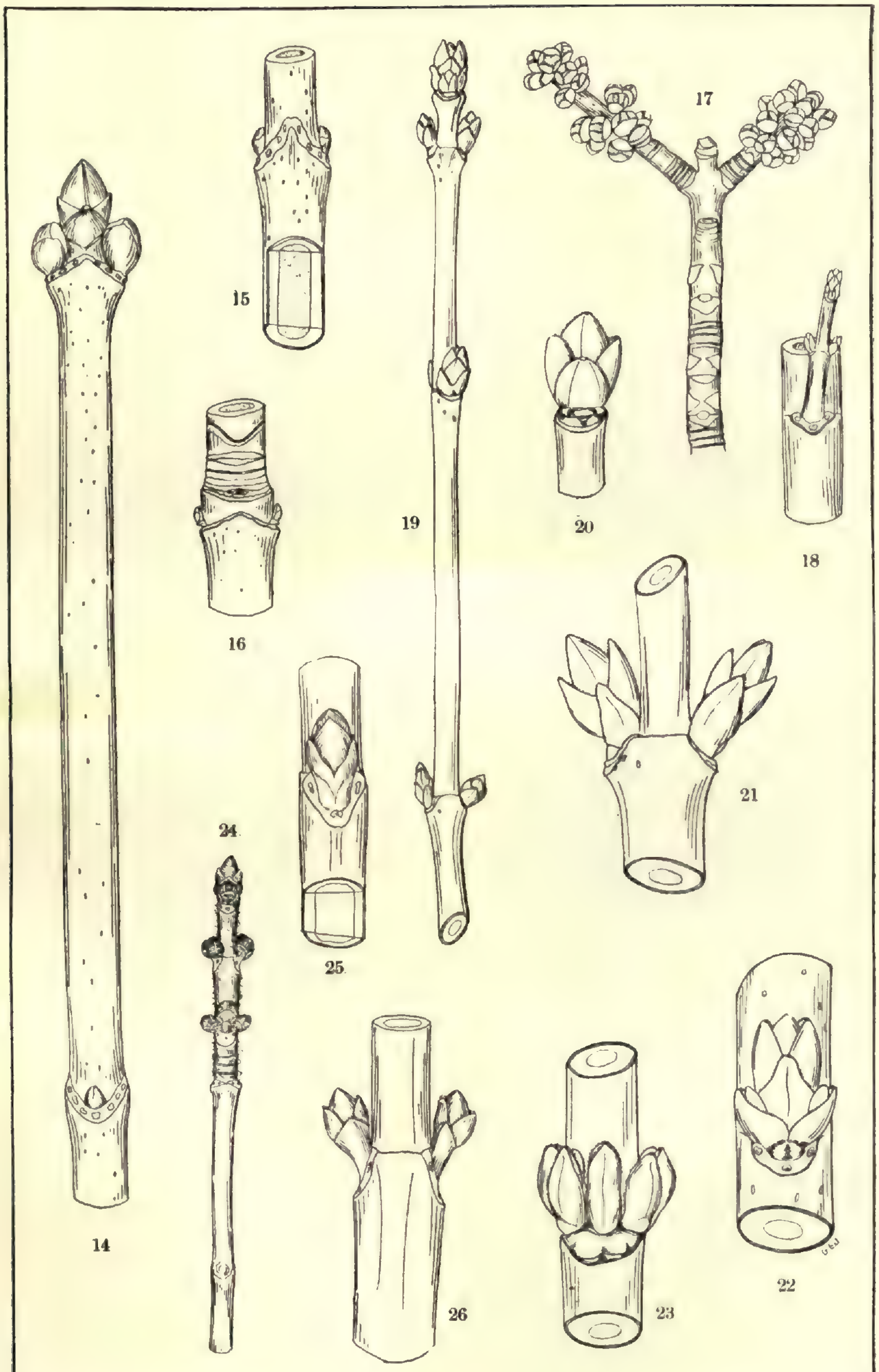
ACER FLORIDANUM VAR. ACUMINATUM.

ACER GRANDIDENTATUM.

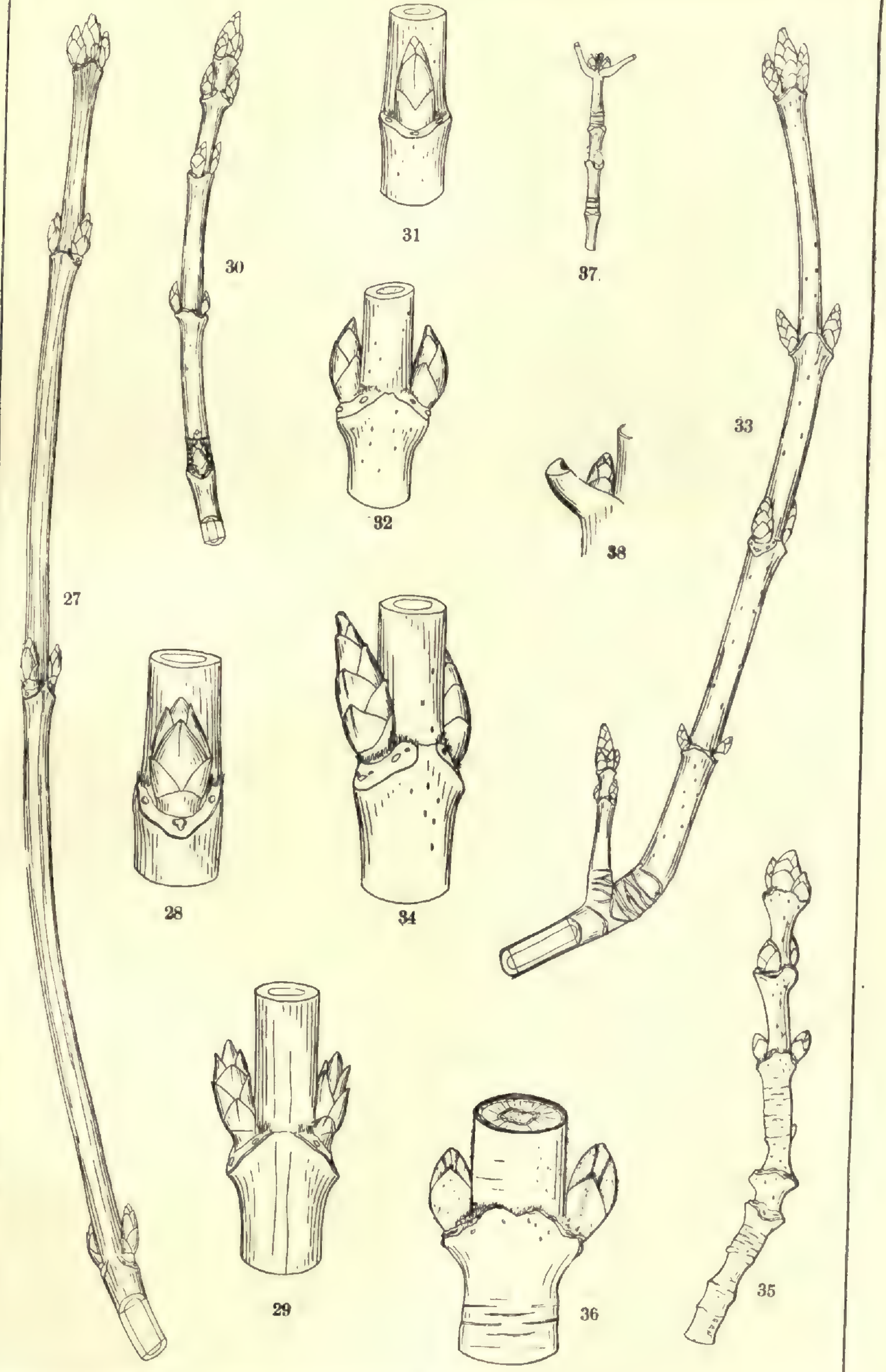
ACER GRANDIDENTATUM.



BUSH AND VINE MAPLES IN WINTER.



SOFT MAPLES IN WINTER.



SUGAR MAPLES IN WINTER.

REVISION OF THE NORTH AMERICAN SPECIES OF GAYOPHYTUM AND BOISDUVALIA.

BY WILLIAM TRELEASE.

Though few in numbers, our species of Gayophytum and Boisduvalia are difficult because of the great variability of several species, and as the naming in herbaria is usually much confused, it is hoped that the following revision may facilitate the determination of future collections. In its preparation I have examined the material in the Engelmann herbarium and the general herbarium of the Missouri Botanical Garden, and the collections of Columbia College, Harvard University, the California Academy, and the United States Department of Agriculture, for the use of which I wish to express my thanks. Several western correspondents have also placed me under obligation by contributing specimens for the Garden herbarium.

GAYOPHYTUM, Juss. Ann. Sci. Nat. 1832, xxv. 18, pl. 4; Bentham & Hooker, Gen. Pl. i. 786, 789.

Gayophytum is a small genus of Onagraceae of the aspect of the *paniculatum* group of Epilobium, and also more or less similar in appearance to species of Oenothera of the group Sphaerostigma. From the former it differs by having its seeds quite destitute of a coma, and by its two-celled ovary and fruit, and isolated pollen grains. Oenotheras of similar habit and with equally reflexed sepals, may be distinguished from it by their more elongated calyx-tube, and 4-celled ovary, and the prevailing color of their flowers is yellow, while the flowers of our Gayophytums are white or rose-purple. The bark is very frequently papery-exfoliating at base, as in some Epilobiums.

The geographical distribution of the genus is peculiar. The species represented in our flora are plants of the mountain region of the west. One or two other represent-

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atives, — including the species on which the genus was founded by Jussieu, — occupy the corresponding part of the South American continent; but the genus appears to be entirely absent from the intervening country. None of the species are truly alpine, though several of them reach up to considerable altitudes in the higher mountains; nevertheless the indication is that the former distribution of the genus was continuous along the backbone of both North and South America. Plants of this distribution are often represented also across the North American continent in high latitudes, and not infrequently they occur likewise in Europe, where they enjoy a similar arctic-alpine distribution. In the present case, however, the prototype of the genus appears to be of rather recent differentiation from Oenothera, which is of wide American distribution (one species, Tasmanian, according to Bentham and Hooker), of which genus it represents an accentuated mountain type.

The principal revisions of our species appear in Torrey & Gray, Fl. N. A. i. 512; Watson, Bot. Calif. i. 221; Coulter, Man. Rocky Mt. Bot. 103; and Greene, Flora Franciscana, 218. For other references see Watson, Bibl. Index, 370.

SYNOPSIS.

* Seeds canescent with appressed hairs.
Flowers small, the petals about 1 mm. long..... *G. lastiospermum.*
Flowers large, the petals 3 to 6 mm. long..... *G. eriospermum.*
** Seeds glabrous, either smooth or low papillate.
+ Much forked above, mostly remotely leafy: stigma rather small: pedicels filiform, elongated: capsules subclavate, mostly torulose: seeds rather few, suberect, large, mostly dark colored.
Large flowered, the petals 3 to 6 mm. long: seeds about 1.5 mm. long..... *G. diffusum.*
Small flowered, the petals 1 to 2 mm. long: seeds 1 to 1.5 mm. long. ..... *G. ramosissimum.*
+ + Subsimple or paniculately branched, especially toward the base, densely leafy: stigma large, capitate: pedicels short or almost wanting: capsules neither clavate nor conspicuously torulose: seeds numerous, small, pale.
Capsules narrowly linear, with suberect seeds..... *G. caesium.*
Capsules broadly oblong, flattened contrary to the septum, with very oblique seeds..... *G. pumilum.*

G. LASIOSPERMUM Greene, Pittonia, 1891, ii. 164. — A span to a foot high, loosely dichotomous with filiform branches, the upper leaves and inflorescence more or less canescent with appressed or spreading short hairs; leaves ascending; flowers small, the petals about 1 mm. long; shorter stamens with small anthers; stigma globose, about .3 mm. in diameter; capsules erect, about equaling the subtending leaves, narrowly linear or slightly clavate, scarcely torulose, their slender pedicels about 3 mm. long; seeds mostly numerous, erect, not papillate, finely appressed pubescent, about .46×1.25 mm. (varying from .29 to .60 ×.92 to 1.72 mm). — Washington to Southern California and Nevada.

Specimens examined from Washington (near Mt. Adams, Henderson, Aug. 6, 1892, 2466, and Suksdorf, Aug. 31, 1881, 22; Spokane, Henderson, June 10, 1892, 2467), California (Julian, Dunn, 1888; Congdon, 1889; Pringle, 1881; Cuiamaca Mts., Palmer, 1875, 99; Mojave River, Parish, 1884 and 1886, 1824; Summit, Mrs. Curran, Sept. 1888; Donner, Brandegee, Aug. 1883; Tehachapi, Brandegee, July 1884, and Mrs. Curran; Susanville, Brandegee, July 1, 1892; Lassen Co., hb. Calif. Acad.; Laguna, Cleveland, 1885, 462; San Diego Co., Palmer, 1875, 138, — with seeds as large as in the next, and torulose capsules, and Palmer, 1876, 131 in part; Sierra Co., Lemmon, 1874; Kernville, Coville & Funston, 1891, 1040 and 2167; Ft. Tejon, Coville & Funston, 1891, 1180), and Nevada (Carson City, Anderson, 1864.)

As here understood, this species is quite variable in aspect, the habit of some specimens being that of *ramosissimum*, while others more nearly resemble *caesium*. The numerous usually small seeds recall the latter species, but in some cases the capsules and seeds have more nearly the form and size of those of the former, and it is possible that another species may be separated, intermediate between *lasiospermum* and *eriospermum*.

G. ERIOSPERMUM Coville, Botany of the Death Valley

Expedition, 1893, 103.— Larger and more loosely forked; flowers very large, the petals 3 to 6 mm. long, rosy; anthers and stigma twice as large as in the preceding; capsules more spreading, torulose; seeds few, 1.3 to 1.5 mm. long.— Oregon to Central California.

Specimens examined from Oregon (Camp Harney, Bendire, 1875), and California (Bolander, 1866, 6371; Peru Creek, Rothrock, 1875, 225; Fresno Co., Engelmann, Sept. 13, 1880 — the seeds of some specimens of this collection glabrous and papillate, strongly suggesting hybridity with *diffusum;* Kern Co., Palmer, 1888, 155; Tulare Co., Coville and Funston, 1891, 1316; Siskiyou Co., Pringle, Sept. 6, 1882).

G. DIFFUSUM Torrey and Gray, Fl. 1840, i. 513.— A foot or two high, loosely dichotomous, somewhat canescent above or with spreading hairs throughout; flowers large, the petals about 3 mm. long; stamens all with good anthers; stigma little enlarged, about .25 mm. in diameter; capsules thick, subclavate, torulose, erect or refracted; seeds few, low papillate, about .55×1.3 mm. (varying from .42 to .85×1.05 to 2 mm).— Washington to Central California, Idaho and Northern Utah.

Specimens examined from Washington (Snake River, Fremont, 1843, 782; Spokane River, Cooper, 1860; Falcon Valley, Suksdorf, Sept. 2, 1881, and Howell, Aug. 19, 1882), Oregon (Nuttall; Harford; Klamath Valley, Cronkhite, 1864; Geyer, 546; Cusick, June 1878; Lyall, 1860; Howell, June 1877, and 1880), California (Bridges; Brewer, 1860–2, 1414; Lassen Co., Bryant; Amador Co., Mrs. Wiley, July 1886; Plumas Co., Mrs. Ames, 1874, and Cleveland, June 1882; Alta, Jones, July 3, 1882; Crescent Lake, Kellogg and Harford, 1868, 280; Sequoia Mills, Brandegee, July 19, 1892; Mt. Shasta, Pringle, Aug. 29, 1882; Sierra Nevada Mts., Lemmon, 1875; Sissons, Mrs. Curran, July 1887; Yosemite, Gray, 1872, Torrey, 1865, 112, Bolander, 1866, 4922, Mrs. Curran, July 1883, and Brandegee, July 1883), the Yellowstone Region? (Hayden,

various numbers of 1859–60, in the Engelmann herbarium,—these plants of leafy habit with more ample foliage than usual, and less dichotomous, but too young for satisfactory study), Idaho (Teton Foot Hills, Hayden Expedition, 1872), and Utah (Parley's Park, Watson, July 1869, 404).

G. RAMOSISSIMUM Torr. & Gray, Fl. i. 1840, 513.—A span to a foot or two high, intricately dichotomous with filiform branches, glabrous, appressed canescent above, or very exceptionally with spreading hairs throughout; leaves mostly narrow, usually less conspicuous than in the last, often appressed against the branches; flowers small, the petals 1 to 2 mm. long; stamens in two sets, the shorter ones often with abortive anthers; stigma larger, about .4 mm. in diameter; capsules about 1 mm. thick, oblong to subclavate, often torulose, erect or refracted, on filiform peduncles; seeds few, nearly erect in a single series, papillate, about .5×1.3 mm. (varying from .38 to .80×.84—1.89 mm.), often abruptly dilated one-third above the base.—Washington to the Yellowstone, Arizona and Southern California.

Specimens examined from Washington (Brandegee, 1882, 280, and 1883, 781; Yakima Co., Henderson, May 30, 1892, 2463, and Aug. 3, 1892, 2464; Falcon Valley, Suksdorf, Aug. 2, 1881, 20, and Sept. 2, 1881, 13; North Branch of the Columbia, Wilkes Exped. 1838–42, 1052), Oregon (Geyer, 4 and 547; Hall, 1871, 183; Howell, 1880; John Day Valley, Howell, May 12, 1885; Stein's Mountain, Howell, June 1, 1885), Idaho (Kootenai Co., Sandberg, July 1892), Montana (Birch Lakes, Canby, Aug. 8, 1883, 133), Yellowstone Park (Miss Cooley, June 1891, 4), Rocky Mountains (Nuttall; Hall and Harbour, 1862, 172 for the most part), Black Hills of the Platte (Hayden), Colorado (Central City, Letterman, 1885; Palmer Lake, Miss Eastwood, 1890; Sierra Mojado, Brandegee, June 1877; Fremont Co., Brandegee, 1872, 450; Golden, Greene, 1870; Parry, 1872; Clear Creek, Parry, 1861–2, 124;

Eagle River, Coulter, Aug. 20, 1873; Empire, Patterson, Aug. 13, 1892, 208; South Park, Wolf, 1873, 150 (447); Leadville, Trelease, July 1886; Breckenridge, Mrs. Wislizenus, 1887; Vasey, 1868, 190; Rabbit's Ear Pass, Sheldon, 1884, 186), Utah (Frisco, Jones, June 22, 1880, 1953; Ogden, Tracy & Evans, July 31, 1887, 573; Alta, Jones, Aug. 1, 1879, 1148; Salt Lake City, Watson, May 1869, 401; City Creek Cañon, Jones, Sept. 11, 1882; Palmer, 1877, 157 in part; Antelope Island, Stansbury Exped. June 30, 1850, and Watson, June 1869, 401), Arizona (Williams, Rusby, July 20, 1883), Nevada (Carson City, Anderson, 1864, 239, 282, and Stretch, May 1865; Gray, 1872; Aurum, Jones, June 12, 1893; Soda Springs, Jones, July 20, 1881, 2403; Empire City, Torrey, 1865, 96; Monitor Valley, Watson, July 1868, 401; Virginia Mountains, Watson, July 1867, 401; Palisade, Tracy & Evans, July 26 and 29, 1887, 515), California (Tuolumne, Bolander, 1866, 5059; Brewer, 1860–2, 1711, 1945; Palmer, 1876, 131; Mt. Shasta, Brandegee, July 1887, and Pringle, Aug. 29, 1882 in part, toward *diffusum;* Merced River, Torrey, 1865, 96a; Yosemite, Torrey, 1865, 96; San Jacinto Mts., Parish, July 1881, 1023; Summit, Mrs. Curran, Sept. 1888; Snow Mountain, Brandegee, Aug. 24, 1892; Del Norte Co., Brandegee, Sept. 1885; Donner Lake, Torrey, 1865, 98; Truckee, Brandegee, July 1884, and Mrs. Curran, Sept. 1887).

Specimens apparently referable here, but with larger flowers, the stamens of the two sets subequal, from California (Strawberry Valley, Pringle, Aug. 16, 1881, 108; Big Trees, Bolander, 1866, 6365) and Washington (Falcon Valley, Suksdorf, Aug. 2, 1881, 21). A leafy paniculately branched plant from Sierra Valley, Calif., Lemmon, 1873, with leaves as much as 4×35 mm., apparently belongs here also. The more villous plants can hardly be distinguished from *lasiospermum* except by seed characters. What may be this species was collected by Brandegee at Baja California, L. Cal., May 28, 1893.

Sir William Hooker (London Journ. Bot. 1847, vi. 224), distinguishes two forms of this species, *α. strictipes*, and *β. deflexum*, respectively with erect and refracted capsules (the characters, however, transposed in his descriptions, as has been noted by Dr. Gray in Proc. Phila. Acad. 1863, 61). Both forms are about equally abundant and of similar distribution. Corresponding forms occur in other species, so that it has hardly seemed desirable to maintain the varieties here unless similar varieties are to be admitted for the others.

G. CAESIUM Torr. & Gray, Fl. i. 1840, 514. — *G. racemosum* Torrey & Gr. *l. c.*; *G. Nuttalii* Torr. & Gr. *l. c.* — A span to rarely a foot high, subsimple or diffusely paniculate and fertile from the base, glabrous or with spreading soft pubescence; leaves uniformly distributed along the branches, the upper mostly small and erect; flowers very small, the petals mostly under 1 mm. long; stamens in two sets, the anthers of the shorter ones smaller; stigma globose, large for the genus, .6 to .8 mm, in diameter; capsules .5 mm. wide, narrowly linear, little flattened, nearly sessile, often finely torulose, erect; seeds numerous, nearly erect, smooth, about .36×.93 mm. (varying from .25 to .50×.76 to 1.17 mm).—Oregon to the Yellowstone, Colorado, and California.

Specimens examined from Oregon (Nuttall's type of *Oenothera cresia;* Douglas; Union Co., Cusick, 1877), Idaho (Beaver Cañon, Watson, 1880, 148), Yellowstone region (Hayden, 1859–60 ?, with *diffusum*), Rocky Mountains (Hall & Harbour, 1862, 171, and 172 in part in some sets; Nuttall, types of *O. micrantha* and *O. racemosa* in hbs. Gray and Torrey), Colorado (Empire, Patterson, 1892, 207; Steamboat Springs, Miss Eastwood, July 1891; Breckenridge, Brandegee, 1871, 169), Utah (Alta, Jones, 1879, 1249; Palmer 1877, 157 in part), Nevada, (Aurum, Jones, June 12, 1893 — a canescent form; Carson Valley, Stretch, 1865, 179; Clover Mts., Watson, 1868, 403; E. Humboldt Mts., Watson,

1868, 402 and 403; Flagstaff, MacDougal, 1891, 313), and California (Downieville, Bigelow, 1853–4; White Mts., Coville & Funston, 1891, 1797; Susanville, Brandegee, July 1, 1892; Kern Co., Palmer, 1888, 156a and 156b in part.

It is evident that Nuttall wrote the name *cresia*, on the labels of the specimens preserved in the Gray and Torrey herbaria, but the name published by Torrey and Gray is here adopted. The only reason for preferring this to the name *racemosum* which is now in almost universal use, is its prior position on the page on which both of the synonyms of the species are published. Reflexed fruit occurs on some of no. 1249 Jones.

G. PUMILUM S. Watson, Proc. Amer. Acad. xviii. 1883, 193.—A span or two high, simple or paniculately few branched toward the base, the branches quickly erect, minutely spreading puberulent to mostly glabrous; leaves lanceolate, very acute, rather large, longer than the internodes, the lower spreading; flowers very small, the petals about 1 mm. long; stamens and stigma as in the last; capsules 1 to 1.5 mm. wide, strongly flattened contrary to the septum, nearly sessile, not at all torulose, erect; seeds numerous, very oblique in the cells, smooth, smaller, about .3 × .8 mm. (varying from .25 to .34 × .71 to .97 mm.)—Washington to southern California.

Specimens examined from Washington (Yakima region, Brandegee; Henderson, Aug. 3, 1892, 2465; Falcon Valley, &c., Suksdorf, 1880, 376, June 29 and Aug. 31, 1881; Klickitat River, Suksdorf, 1885, 82), Oregon (Klamath Valley, Cronkhite, 1864; Siskiyou Mts., Howell, July 19, 1887, 1141), Nevada (Reno, Brandegee, Sept. 1887), and California (Fresno Co., Engelmann, Sept. 13, 1880; Kellogg, 1870; Kern Co., Palmer, 1888, 156b in part; Sierra Co., Lemmon, 1874 in part, and Parry and Lemmon, 1876, 131; Headwaters of Sacramento, Pringle, Sept. 1, 1882; San Bernardino, Parish, 1892, 2372, and Parry, May 1876; Trinity River, Rattan, June, 1883; Lake Co., Torrey, 1865,

97; Truckee, Sonne, 1886, 112, and Brandegee, July 1884; Bartlett Mt., Brandegee, June 1884; Snow Mt., Brandegee, June 1891; Sequoia Mills, Brandegee, July 1892).

G. strictum, Gray, Proc. Amer. Acad. vii. (1867), 340, according to Watson (Bibl. Index, 363), and the type specimens, is Boisduvalia Torreyi.

The genus *Gayophytum* was founded on a South American species, *G. humile* Juss.,* of Chili and Peru. The original plate of Jussieu, and Gay's plate for a tracing of which I am indebted to Mr. Hemsley, show that this species is nearly identical with *G. pumilum*, having flattened capsules with numerous oblique seeds. Specimens referable here occur in the herbarium of the California Academy, from the mountains about Santiago, as *G. humile* Juss. and *G. densifolium* Ph., and it may be questioned whether study of additional material may not necessitate the adoption of Jussieu's name for the North American plant which now bears the name of *pumilum*. *G. micranthum* Hook. & Arnott, in Hook. Bot. Miscell. iii. 311 (*Oenothera micrantha* Presl, Rel. Haenk. ii. 31 †), which is generally held to be the same as *humile*, is represented in the Gray herbarium by a fragment from Hooker, which has the elongated internodes, dichotomous habit, clavate torulose capsules on filiform pedicels, and few large dark seeds, of the *ramosissimum* group, and from this fragment one would hesitate to call it different from the latter, but it is possible that some error has occurred in the labeling. Apparently of a single species, separable from *humile*, are the following specimens in the herbarium of the California Academy, from the Andes near Santiago: — *G. minutum*, Ph., *G. gracile*, Ph., and *G. robustum*, Ph., — all of which appear more closely related to *caesium* than to any other species. I am disposed to think that these (together with

* Jussieu, Ann. Sc. nat. 1832, xxv. 18, pl. 4; Gay, Flora Chilena, ii. 324, pl. 22.

† Dating from 1825, as Mr. Hemsley informs me.

the Hooker fragment referred to above?) should all bear the name *micranthum*.

BOISDUVALIA, Spach, Hist. Nat. des Vég. 1835, iv. 383, and Atlas, pl. 85, f. 2; Monogr. Onagrearum, 1835, 398, pl. 31, f. 2; Benth. and Hook., Gen. Plant. i. 790, — as section of *Oenothera*.

Like Gayophytum, this is a small group, confined to the mountains of Western North and South America, what has been said of the distribution of the former genus applying equally to this, except that our species are more closely confined to the Pacific coast. In general habit it approaches closest to Oenothera, with which Bentham and Hooker unite it, but in aspect it differs from most species of Oenothera proper, from which it also differs (so far as our species are concerned) in its short, nearly basifixed anthers in two sets, erect calyx lobes, and pollen grains adnate in tetrads. It is also closely related structurally to Epilobium, from which it differs in aspect, and in its seeds destitute of a coma. In my study, I have thought best to follow most American botanists in treating it as a distinct genus. The principal revisions of our species appear in Torrey & Gray, Fl. N. A., i. 505 (under *Oenothera*); Watson, Bot. Calif. i. 233; Behr, Flora of the vicinity of San Francisco; and Greene, Flora Franciscana, 224. — For other references see Watson, Bibl. Index, 362, and Jackson, Index Kewensis, i. 318.

SYNOPSIS.

* Capsule membranaceous, loculicidal, a considerable portion of the septa remaining attached to the valves on dehiscence.

Leaves ovate lanceolate, toothed, the upper not reduced: seeds minute, fusiform.....*B. glabella.*

Leaves narrowly lanceolate, nearly entire, the upper small: seeds broad and flattened.....*B. stricta.*

** Capsule membranaceous, septifragal, the septa wholly adherent to the placenta, rendering the latter strongly 4 winged: leaves lanceolate, toothed, the upper broader.....*B. densiflora.*

*** Capsule coriaceous, 4 sided, very tardily (loculicidally?) dehiscent: leaves narrowly lanceolate, toothed, the upper not enlarged. .....*B. cleistogama.*

B. GLABELLA (Nutt.) Walpers, Repert. 1843, ii. 89; Watson, Bot. Calif. 1876, i. 233; Index, 362, — *Oenothera glabella* Nutt. in Torrey & Gray, Flora, 1840, i. 505.— A span or two high, simple or mostly decumbently branched near the base and frequently with ascending branches above, bluish, densely soft villous to glabrous; leaves half an inch long, ovate lanceolate, acute, serrulate, the upper similar; flowers in a terminal cluster and a few shorter lateral spikes, also occasionally in the lower axils, shorter than the subtending leaves; corolla about 2 mm. long, violet; capsules rather slender, nearly straight, usually acute, about 7 mm. long, subterete with 4 broad nerves or laterally somewhat 2-keeled, loculicidal; seeds about 6 in each cell, subfusiform, small, about .35×1 mm. (varying from .25 to .42 × .84 to 1.26 mm.).— British Columbia to Montana, Nevada, and southern Californa.

Specimens examined from British Columbia (Cypress Hills, Macoun, 1880, 67; Bullrush Lake, Macoun, July 25, 1880,— both with narrower leaves than usual), Washington (Pullman, Henderson, July 17, 1892, 2469), Oregon (Hall, 1871, 190; Walla Walla, Nuttall; Howell, 1887, 702; Grant's Pass, Howell, 1887, 1145; Wasco Co., Suksdorf, 1886, 862), Montana (Sand Coulee, Anderson, July 1887; Deer Lodge?, Notestein, 1892), Nevada (Carson Valley, Watson, Aug. 1867, 413; Truckee Valley, Bailey, 1867, 413), and California (Vasey, 1875; Mrs. Austin, July 1884, 176; Elmira, Mrs. Curran, Aug. 1883; San Diego, Cleveland, 1882, 868, and Orcutt, 1887, 1119; San Luis Obispo, Brandegee, July 1886, and Palmer, 1876, 145½; Santa Monica, Hasse, June 1892; Siskiyou Co., Greene, 1876, 892; Gilroy, Brandegee, June 1885; Antioch, Brandegeé, June 8, 1892; Mt. Eden, Brandegee, June 16, 1893; Snow Mt., Brandegee, June 23, 1891 and Aug. 1892; Byron, Brandegee, June 9, 1892; Monterey Co., Congdon, June 1881).

B. STRICTA (Gray). — *Gayophytum strictum* Gray, Proc. Amer. Acad., 1867, vii. 340. — *Oenothera Torreyi*

Watson, Proc. Amer. Acad. 1873, viii. 600.— *O. densiflora* var. *tenella* Gray, Proc. Amer. Acad. 1873, viii. 384.— *Boisduvalia Torreyi* Watson, Bot. Calif. 1876, i. 233; Index, 363.— A foot to a foot and a half high, slender, simple or with a few long erect virgate branches chiefly toward the base, densely villous, often hoary; leaves commonly under 1 in. long, narrowly lanceolate, acute, entire or minutely denticulate, the upper shorter and not widened; flowers axillary along the branches, about equaling the leaves; corolla 2 to 4 mm. long, violet; capsules slender, generally curved outwards, tapering above, more or less 2-edged, about 10 mm. long, loculicidal, the lateral nerves commonly heavier; seeds 6 to 8 in each cell, similar to those of *densiflora* but smaller, about .5×1 mm. (varying from .38 to .63×.88 to 1.6 mm.).— Washington to Idaho and Central California.

Specimens examined from Washington (Brandegee, 1882 and 1883, 788; Seattle, Piper, 1888, 411; Spokane, Henderson, 1892, 2468 in part, and Sandberg, Aug. 1892; Klickitat Co., Suksdorf, Aug. 8, 1881; Falcon Valley, Suksdorf, Aug. 1880, 378, and July 3, 1882), Oregon (Henderson, 1882, 360; Howell, Aug. 1880; Hall, 1871, 189; Grant's Pass, Howell, June 23, 1884; Idaho (Kootenai Co., Heller, 1892, 905), and California (Rockville, Earle, Aug. 1, 1880; Yreka, Greene, 1876, 853; Humboldt & Sonoma Counties, Bolander, 1866–7, 6535; Almaden, Torrey, 1865, 109; Borax Lake and Bear Mountain, Torrey, 1865; Sta. Lucia Mts., Vasey, July 1880, Kernville, Coville and Funston, 1891, 1041; Lake Co., Brandegee, July 1884, and June 1890; Howell Mt., Brandegee, Aug. 1888; Plumas Co., Brandegee, July 4, 1892; Byron Sta., Greene, May 24, 1886; Newcastle, Brandegee, July 5, 1889; Sonoma, Brandegee, June 1892; Modoc Co., Mrs. Austin, Aug. 1885; Humboldt Co., Mrs. Bush.)

B. DENSIFLORA (Lindley) Watson, Bot. Calif. 1876, i. 223; Index, 362. — *B. Douglasii* Spach, Hist. Nat. Végétaux, 1835, iv. 385, atlas, pl. 85, f. 2; Monographia

Onagrearum, 1835, 400, pl. 31, f. 2. — *Oenothera densiflora* Lindley, Bot. Reg. 1833, xix. pl. 1593. — Mostly a foot or two high, simple or with few ascending branches, green to hoary, more or less villous; leaves 1 to 3 in. long, lanceolate, acute, denticulate to rather sharply serrate, the upper abruptly becoming shorter, broadly ovate, acuminate, mostly entire, sometimes much crowded; flowers in an often dense terminal spike, similar but shorter clusters ending the branches; corolla 12 mm. long, deep violet, mostly exceeding the subtending leaves; capsules stout, straight, usually blunt, terete, about 7 mm. long, shorter than the leaves, septifragal, with 4 broad but low nerves; seeds rarely over 6 in each cell, pale at both ends, generally very concave on the inner face and much deformed by mutual pressure, about .9 × 1.7 mm. (exceptionally varying from .63 to 1.26 × 1.26 to 2.31 mm.). — Vancouver Island and Washington to Nevada and Lower California.

Specimens examined from Vancouver (Macoun, July 9 and Aug. 27, 1887), Washington (Brandegee, 1883, 787; Yakima Co., Henderson, May 27, 1892, 2470; Seattle, Smith, July 6, 1889, 108; Piper, July 1 and Aug. 9, 1888, 2761, and Miss Shumway, May 1892; Klickitat Co., Suksdorf, Aug. 8, 1881, 15), Oregon (Hall, 1871, 185, 186, 187, 188 in part; Lyall, 1860; Newberry, Williamson Survey; Kellogg & Harford, 1868–9, 1152; Douglas; Geyer, 591; Nuttall — types of *imbricata*, *salicina*, and *salicina albiflora;* Dalles, Brandegee, 1882; Grant's Pass, Brandegee, Sept. 1885; Clear Water, Spalding), California (Fitch; Kellogg & Harford, 1868–9, 275; Vasey, 1875; Brewer, 1860–2, 811; Alta, Pringle, Sept. 29, 1882; Sierra Nevada Mts., Lemmon, 1875; Susanville, Brandegee, July 2, 1892; Sonoma Co., Samuels, 72; Sonoma Valley, Torrey, 1865, 104; Sta. Lucia Mts., Vasey, July 1880, 205 and an albino, Brandegee, 1886; Placer Co., Vasey, 1880; Jolon, Vasey, July 1880, 206; Kern Co., Palmer, 1888, 141 — an albino; Oakland, Jones, 1881, 2358; Stanislaus

River, Bigelow, 1853–4; Healdsburg, Bryant, July 1887; Napa Co., Brandegee Aug. 1888; Folsom, Brandegee, July 1883; Adobe Flats, Mrs. Austin, July 1884, 118; Mt. Tamalpais, Jepson, Sept. 9, 1892, and Brandegee, July 1891; Yosemite, Torrey, 1872; Yreka, Greene, 1876, 947; Monterey, Nuttall; Auburn, Vasey, Oct. 1880; Peru Creek, Rothrock, 1875, 235; Truckee, Jones, 1881, 392a; Nevada Co., Jones, 1881, 2715), Nevada (Carson City, Anderson, 1864, 26, 54, 118; Yolo, Brandegee, Sept. 20, 1892; Palisades, Brandegee, 1886; Modoc Co., Mrs. Austin, Aug. 1885; Verano, Heaton, 1888; Sta. Cruz Mts., Price, 1890; Ukiah, Mrs. McCowen, June 1892), and Lower California (Orcutt, July 30, 1883).

The typical, usually green form, with ample serrate leaves, large bracts and dense inflorescence, passes into a grayer form with longer spikes and smaller bracts, and this in turn grades into var. . of Torrey and Gray's Flora, which is the *Oenothera salicina* of Nuttall, and is very canescent, with narrower leaves and bracts, smaller flowers and slenderer capsules. Variety *imbricata* Greene, is a virgate form, in wet ground becoming six or seven feet high, with the floriferous branches as much as two feet and a half long (Jepson, Erythea, i. 241 and 244). I do not see how to separate these forms as even varieties, although as here defined, *densiflora* is far more variable than the other species of the genus. Specimens from California (Yreka, Greene, 1876, 853; Sta. Lucia Mts., Vasey, July 1880), and Washington (Falcon Valley, Suksdorf, Aug. 3, 1882, 56, July 30, 1885, 343, 557 and 558), are variously intermediate between this species and *stricta*, in bract, flower, capsule and seed characters, as well as in habit, and are indicative of hybridity or a possible intermediate species which I cannot define.

A portion of Hall 188 is *Oenothera lepida*, var. *parviflora*, as noted by Mr. Watson on several sheets; but this may be distinguished by its larger acuminate buds, more strigose pubescence above, larger capsules and entire leaves

with incurved tomentum, though in habit it bears a rather close resemblance to *B. densiflora*.

B. CLEISTOGAMA Curran, Bull. Calif. Acad. 1884, i. 12; Mrs. Brandegee, Zoe, iii. 370.— A span or two high, decumbently branched from the base, very villous to glabrous except for a few spreading hairs; leaves pale, an inch or two long, lanceolate to linear lanceolate, acute, remotely denticulate to sharply serrulate, the upper similar; flowers axillary along the branches, shorter than the subtending leaves, "the earlier ones fertilized in the bud and never expanding;" corolla rose purple, 2 to 4 mm. long; capsules stout, spreading from the stem, acute, 10 to 15 mm. long, sharply 4-sided and with 4 intermediate nerves, (tardily loculicidal?), much surpassed by the leaves; seeds numerous, about .5 × 1.4 mm.— California (Antioch, Brandegee, May 1886; Elmira, Mrs. Curran, May and Aug. 1883).

In aspect this is between *glabella* and *stricta*, but its capsular characters are quite unlike those of other species.

Besides these North American species, Jackson enumerates the following Chilian species, referring them to Oenothera: — *B. andina* Phil., *B. concinna* Spach, *B. Tocornalii* Gay, and *B. Volckmanni* Phil., — which I have not in sufficient material to warrant a revision of the South American forms.

EXPLANATION OF PLATES.

The figures were drawn from herbarium specimens by Miss Grace E. Johnson, under supervision of the author, and details are from his sketches.

Plate 17, *Gayophytum lasiospermum*. — 1, Habit, natural size; 2, capsule, enlarged; 3, dehiscent capsule, × 5; 4, hair from ovary, × 200; 5, stigma, × 37; 6, three seeds, × 18.

Plate 18, *G. eriospermum*. — 1, Habit, natural size; 2, branch, × 2; 3, long and short stamen, from one flower, × 18; 4, pollen grain, × 200; 5, two stigmas, × 37; 6, seed, × 18; 7, seed of the *diffusum* type, from an Engelmann specimen.

Plate 19, *G. diffusum*. — 1, Habit (from a Nuttall specimen), natural

size; 2, flower, × 3; 3, stigma, × 37; 4, two capsules, somewhat enlarged; 5, seed, × 18.

Plate 20, *G. ramosissimum.* — 1, Habit, natural size; 2, two stigmas, × 37; 3, stamen, × 18; 4, germinating pollen grain, × 200; 5, elongated erect capsule, × 5; 6, shorter deflexed capsule, × 5; 7, capsule in section, × 15; 8, two seeds, × 18.

Plate 21, *G. caesium.* — 1, Habit, natural size; 2, flower, × 9; 3, stigma, × 37; 4, capsule, × 5; 5, section of capsule, × 15; 6, seed, × 18.

Plate 22, *G. pumilum.* — 1-2, Habit, natural size; 3, flower, × 3; 4, stigma, × 37; 5, capsule, × 5; 6, section of capsule, × 15; 7, two seeds, × 18.

Plate 23, *Boisduvalia glabella.* — 1, Habit, half size; 2, branch, half size; 3, two stigmas, × 18; 4, two pollen tetrads, × 200; 5, capsule, × 1; 6, two seeds, × 18.

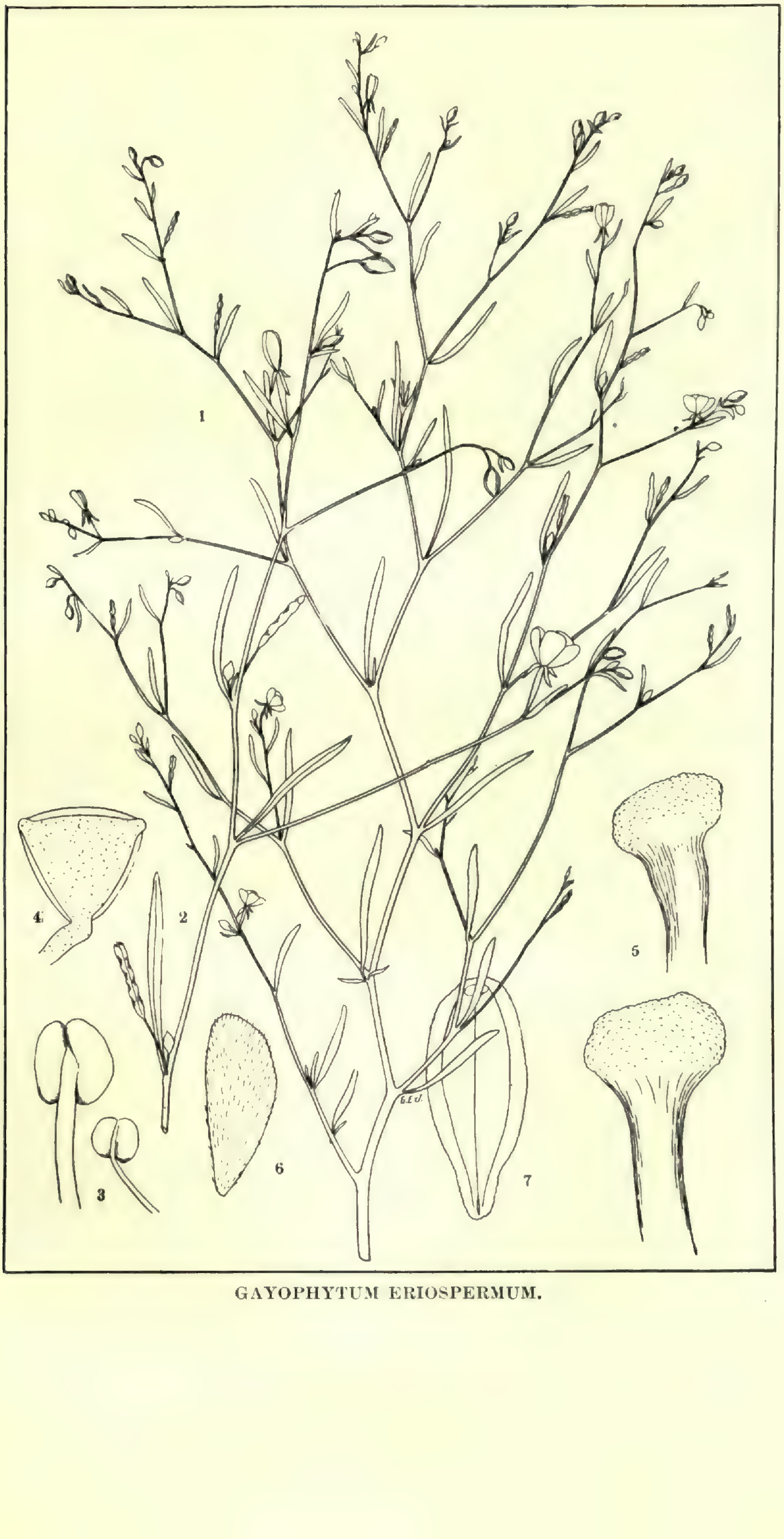
Plate 24, *B. stricta.* — 1, Habit, half size; 2, branch, natural size; 3, opened flower, × 9; 4, stigma, × 18; 5, capsule, × 5; 6, four seeds, × 18; 7, pollen tetrad, × 200; 8, glandular and non-glandular hairs, × 200.

Plate 25, *B. densiflora.* — 1, Branch, half size; 2, diagramatic section of flower, enlarged; 3, pollen tetrad, × 200; 4, capsule and bract, natural size; 5, capsule, × 3, and section × 3; 6, two seeds, × 18.

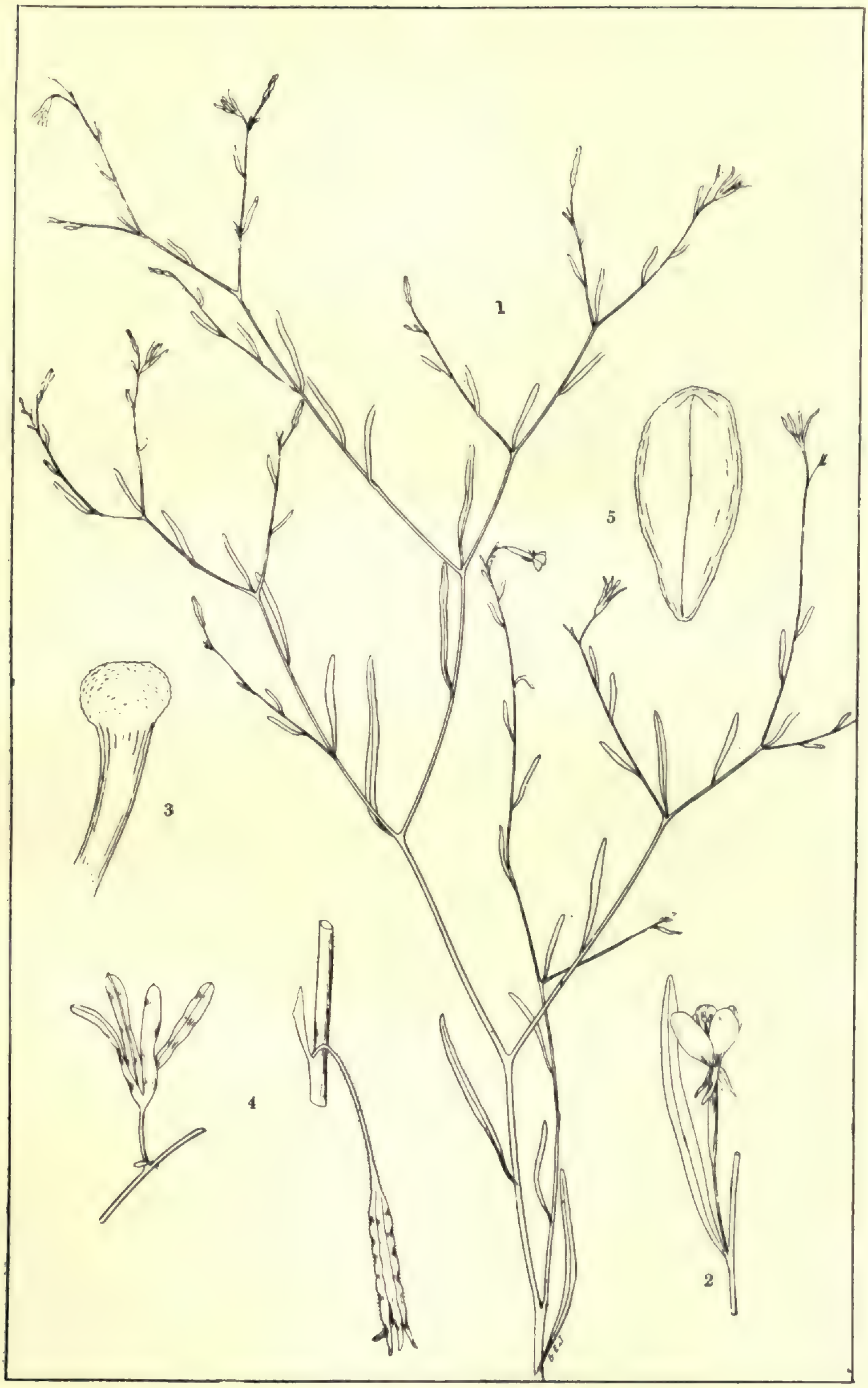
Plate 26, *B. c leistogama.* — 1, Habit, half size; 2, smaller plant, natural size 3, capsule, × 5, and section, × 5; 4, stigma, × 18; 5, seed, × 18.

Since the preceding pages were written, Raimann's elaboration of Onagraceae in parts 94 and 96 of Engler's Pflanzenfamilien has been received. *Gayophytum* is treated on pp. 206 and 217, with figure 92, e–g, (*G. diffusum*); and *Boisduvalia*, on pp. 205 and 212, with figure 88 (*B. densiflora*).

GAYOPHYTUM LASIOSPERMUM.

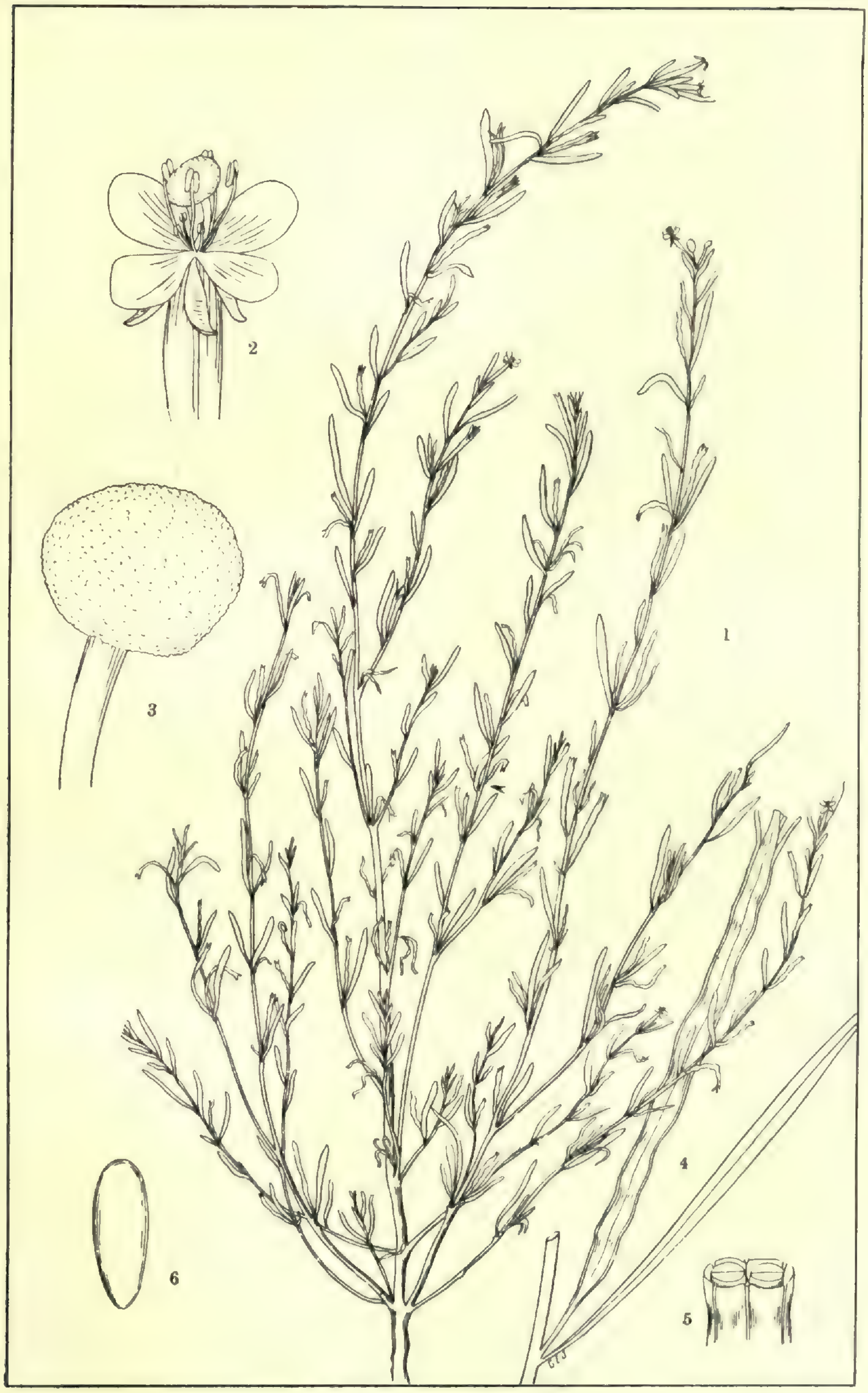


GAYOPHYTUM ERIOSPERMUM.



GAYOPHYTUM DIFFUSUM.

GAYOPHYTUM RAMOSISSIMUM.



GAYOPHYTUM CAESIUM.

GAYOPHYTUM PUMILUM.

BOISDUVALIA GLABELLA.

BOISDUVALIA STRICTA.

BOISDUVALIA DENSIFLORA.

BOISDUVALIA CLEISTOGAMA.

PHENOLOGICAL NOTES AT THE MISSOURI BOTANICAL GARDEN, FOR 1892 AND 1893.

BY J. C. WHITTEN.

During the last two years phenological observations have been made upon various plants in the arboretum. The notes on herbaceous plants and such woody plants as grow in the bog, were made in 1892 by Thomas Doss. His notes for 1893, on the same plants, were unfortunately lost. Notes upon the other woody plants were made in 1892 by F. W. Dewart and in 1893 by the writer, whom the Director of the Garden has requested to prepare these notes for publication.

Students of natural history have, from time to time, published observations upon the date of leafing, flowering and fruiting of plants, have cited the relation of climate to plant growth, and touched upon the importance of this study to the practical cultivator. Among American publications upon the subject may be mentioned those by Britton, in the Bulletin of the Torrey Botanical Club, vi, 211 and 235; Henry, in the Report of the Board of Regents of the University of Wisconsin, 1891, p. 35; Trelease, in the Report of the Agricultural Experiment Station of the University of Wisconsin for 1883, p. 56, 1884, p. 59; Halsted, in Iowa Agricultural College Bulletin, 1886, p. 43; and Pammel in Bulletin of the Torrey Botanical Club, xix, 375. An article on "the philosophy of the flower seasons," by Henry L. Clarke, appeared in The American Naturalist of September, 1893.

These observations are of value from several stand-points. The time of leafing, flowering and fruiting of a species

largely governs its position and importance in planting. In selecting specimens it is desirable to know the date that each blooms, so that the different species of the collection, flowering at different times, may represent the longest possible period of bloom.

Very early bloomers like Forsythia, autumn flowering sorts, like Witch Hazel and all those that flower when there is little else to gladden the eye, are always sought. For landscape effect, the time of leafing and fruiting is of equal importance. The Virginia Creeper, while it is an excellent summer cover, is perhaps most appreciated for a short time in autumn, when it assumes that crimson tinge, quite in keeping with the season, after many of the deciduous sorts have shed their leaves. The fact that some sorts carry their fruit into the winter months adds much to their value and helps to determine their relative positions in a planting. The ripening rose hips, turning from green to golden, red and brown, the fruits of Euonymus or Burning Bush, the Christmas Holly, with its bright red berries, rich foliage and rugged twigs, each have a winter beauty that is best brought out after a careful study of their phenological characteristics.

The different stages of the season's growth of trees and shrubs indicate to the meteorologist conditions of temperature that cannot be definitely arrived at by any mechanical method. While the thermometer may register the actual temperature of the atmosphere or soil at any given time, it does not, by any means, measure the sum total of heat that has been received, during a given period, as does a certain stage in the development of buds or leaves. This fact is taken advantage of by the cultivator. In planting for a succession of vegetables, for example, a difference of four weeks, in sowing the seed, may result in a difference of only one or two weeks in maturing the plants for the table. The time to plant, then, may be indicated by the rapidity of growth of trees and shrubs.

The phenological characteristics of plants also aid in

determining species. Most species of the wild grape, for example, have periods of flowering that are relatively quite definite. This is an aid to the botanist in classifying specimens that are otherwise variable.

In the following tables the herbaceous and woody plants are listed separately for more convenient reference to each class. The nomenclature of North American species conforms to Patterson's Check List of North American Plants, which is easily accessible, while its nomenclature is universally known.

To facilitate comparison with the phenology of plants in Europe, an asterisk is placed after species included in the list of the Royal Meteorological Society of Great Britain,* and a dagger is placed after species included in the list of the Botanischer Verein der Provinz Brandenburg.† In the notes on woody plants, (1) indicates that at the time of writing (Jan. 25, 1894) the leaves have not entirely fallen, and (2) indicates that some fruit remains on the plant through the winter.

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* Cf. list of Rev. T. S. Preston, 1883, etc.

† Magnus, Tabellarische Zusammenstellung phaenologischer Beobachtungen, 1893.

HERBACEOUS PLANTS, 1892.

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Actaea alba	Apr. 23	Apr. 2	July 12	May 16	Aug. 13	Oct. 5
" spicata, var. rubra	" 21	May 16	May 22	June 20	July 18	" 30
Ageratum Mexicanum	May 10	Aug. 25	Sept. 2	Sept. 2		" 11
Agropyrum dasystachyum	" 26	June 10	June 20	June 29	" 12	" 23
Alisma Plantago...	" 23	July 20	Aug. 1	Aug. 29	Sept.17	Nov. 6
Allium reticulatum.	" 17	June 11	June 22	June 30	July 7	July 30
" cernuum ...	June 7	July 21	Aug. 12	Aug. 3	Aug. 20	Sept. 17
" platycaule..	May 1	May 6	May 29	June 1	June 9	Aug. 23
Amianthium Muscaetoxicum		" 28	June 15	" 19	July 20	Sept. 29
Ambrosia trifida...	" 2	Aug. 24	Aug. 31	Sept. 7	Sept.18	" 29
Anemone acuta....	" 10	Apr. 2	May 15	May 2	May 26	Oct. 25
" dichoctoma		May 27	July 10	June 29	Sept. 9	" 17
" Hepatica ..	" 12	Apr. 4	May 18	May 3	May 27	" 1
" Virginiana.	June 2	June 22	July 11	July 13	Aug. 11	" 13
Anemonella thalictroides	May 3	Apr. 18	May 2	May 16	May 27	Sept. 11
Angelica atropurpurea	" 16	June 23	July 11	July 19	Aug. 30	" 15
Antennaria plantaginifolia	June 18	July 24	" 31	Aug. 14	" 14	Oct. 2
Aquilegia caerulea.	May 8	May 15	June 7	June 4	July 5	
" Canadensis	" 6	Apr. 27	" 4	" 26	" 5	" 19
" formosa ..	" 7	May 14	" 9	" 12	" 2	Nov. 28
Aralia nudicaulis..	" 10	" 16	May 30	" 13	" 17	Oct. 2
" quinquefolia	" 15	June 16	June 29	" 26	" 9	Aug. 15
" racemosa...	Apr. 23	" 18	" 29	July 9	" 23	Oct. 15
Arenaria Michauxii	May 10	May 25	" 15	June 24	" 29	Sept. 28
" stricta ...	Apr. 23	" 24	" 18	" 21	" 23	Oct. 9
Arisaema triphyllum		Apr. 29	June 10	June 7	July 2	Aug. 29
Asarum arifolium..	May 1	May 6	" 2	May 19	" 18	Nov. 30
" Canadense.	" 1	" 5	May 25	" 15	June 7	" 15
Asclepias incarnata	" 30	June 24	July 26	July 28	Aug. 18	Oct. 27
" quadrifolia	" 12	May 28	June 2	June 19	June 19	Aug. 19
" tuberosa...	" 10	July 11	July 19	Aug. 14	Aug. 30	
Bidens chrysanthemoides	June 5	June 27	" 7	July 16	July 29	Sept. 26
Blephilia ciliata ...	May 17	" 15	June 23	" 8	" 13	Oct. 5
Boehmeria cylindrica	June 1	July 15	Aug. 10	Aug. 19	Sept. 1	" 29
Bouteloua racemosa	" 11	June 25	July 1	July 20	Aug. 19	Nov. 9
Brachyelytrum aristatum, var. Engelmanni	" 7	" 25	" 17	" 30	" 25	" 7

HERBACEOUS PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Brasenia peltata...	Apr. 25					
Brevoortia coccinea	May 15	June 6	June 16	June 14	June 27	
Brodiaea capitata..	" 20	" 9	" 17	" 19	" 29	
" congesta...	" 14	" 6	" 19	" 19	" 30	July 25
" grandiflora	June 12	" 23	" 27	July 5	July 9	" 16
" Howellii ..	May 12	May 3		May 14		May 5
" ixioides ...	" 1	June 8	" 20	June 15	June 30	July 25
" multiflora.	" 12	" 1	" 30	" 12	July 24	" 18
Bromus secalinus..		May 23	" 19	" 14	" 13	Nov. 9
Brunella vulgaris..	" 11	June 14	July 2	Aug. 10	Aug. 30	Oct. 3
Cacalia tuberosa...	" 7	" 25	" 29	July 9	" 20	Sept. 17
Calandrinia compressa..	" 20	" 1	June 20	June 15	July 2	July 16
" procumbens	" 18	" 1	" 17	" 11	June 29	" 11
Calla palustris.....	" 2	May 4	" 23	" 20	July 18	Aug. 13
Callirrhoe involucrata	June 1	June 18	" 26	July 8	" 20	Oct. 26
Calochortus caeruleus.	May 13	May 19	May 25	May 30	" 9	July 3
" lilacinus..	" 18	" 25	June 3	June 8	" 11	Aug. 15
" pulchellus	" 15	" 25	" 15	" 2	" 2	" 9
Caltha palustris*..	" 10	Apr. 14	May 18	May 27	June 2	July 16
Calypso borealis...	" 4	" 29		" 17		June 16
Camassia esculenta	" 1	May 7	" 16	" 20	May 30	Aug. 19
Cannabis sativa....	" 2	" 16	June 28	June 9	Sept. 2	Oct. 29
Carex grisea.....	" 3	" 18	" 24	" 5	Aug. 29	Dec. 7
" plantaginea .	" 11	" 20	" 5	" 2	June 30	Nov. 29
" Shortiana ...	" 10	" 14	May 24	May 28	July 25	" 19
" tribuloides, var. cristata	" 12	" 18	June 16	June 10	" 20	Dec. 6
Caulophyllum thalictroides	Apr. 23					
Chamaelirium Carolinianum	" 27					
Chenopodium opulifolium	May 12	" 15	" 2	" 29	" 8	July 20
ChionodoxaLuciliae	" 3			Apr. 9	May 14	May 19
Cimicifuga racemosa	" 4					
Claytonia Caroliniana	" 1	Apr. 4	May 2	May 14	" 9	Aug. 10
" parviflora .	" 12	May 26	June 9	June 29	July 2	Oct. 27
" Virginiana	" 2	Apr. 18	May 11	May 9	May 18	July 11
Clintonia borealis..	" 1	May 3	" 19	June 11	June 23	Sept. 20
Conioselinum Canadense	" 15	" 24	June 22	" 14	Aug. 11	Oct. 27
Crepis intermedia..	June 4	June 22	Aug. 10	July 19	Sept. 6	" 1
Cynoglossum officinale	May 10	May 18	June 3	Aug. 10	Sept. 3	Oct. 15
Cypripedium acaule	" 2	" 5	May 31	May 21		Aug. 19
" arietinum	Apr. 25	" 3	" 12	" 14	May 18	" 27
" candidum	May 5					

HERBACEOUS PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Cypripedium						
" pubescens	Apr. 25	May 2	May 12	May 17	May 30	Aug. 30
" spectabile	May 12	" 20	" 28	June 7	June 20	" 29
Darlingtonia						
Californica	July 2	" 6	June 21	June 10	July 2	Oct. 14
Datura inermis....	May 18	June 10	Aug. 8	July 7	Aug. 30	Sept. 26
Decodon						
verticillatus	" 12	Aug. 20	" 31	Sept. 12	Sept. 12	Nov. 3
Delphinium						
tricorne	" 1	May 2	June 2	May 25	June 18	June 28
Dentaria laciniata..	Apr. 9	" 22	May 1	" 30	" 3	Sept. 12
Diclytra cucullaria.	May 4	Apr. 21	" 6	" 1	May 6	June 4
" eximia ...	" 16	" 27	June 1	Oct. 6	Oct. 27	Nov. 19
" formosa ..	" 1	May 2	" 1	Sept. 29	" 9	
Dodecatheon						
ellipticum.	Apr. 20	" 7	" 3	May 21	July 14	Aug. 12
" Hendersoni	" 22	" 3	" 12	" 18	" 13	" 9
" Meadia....	" 20	" 5	" 15	" 31	" 8	" 1
Epigaea repens....	May 3	Apr. 23		" 15	June 17	Nov. 9
Epilobium alpinum	June 1	June 8	" 14	June 17	" 29	July 17
" alsinaefolium	May 16	" 15	" 23	" 30	July 13	Aug. 16
Erodium						
Stephanianum	" 13	May 17	" 19	May 28	" 21	Sept. 9
Erythronium						
grandiflorum	" 2	Apr. 1		Apr. 16		
Eupatorium						
ageratoides .	" 18	Aug. 26	Sept. 12	Sept. 30	Oct. 9	Oct. 22
" sessilifolium	" 13	" 25	" 11			
Euphorbia corollata	" 15					
" Darlingtonii	Apr. 24	May 12		June 29	July 6	Nov. 7
Fagopyrum						
Tataricum	May 12	" 23	June 7	" 19	" 18	Oct. 17
Fragaria vesca†....	" 1	" 4		May 19		June 5
Fritillaria						
parviflora	" 1	" 3		" 13		May 18
" pudica...	" 1	Apr. 1		Apr. 15		" 15
Gentiana Andrewsii	" 26	Aug. 30	Sept. 20	Sept. 20	Oct. 9	Oct. 28
" linearis ..	" 26	Sept. 5		" 20		" 28
Goodyera repens...	" 18	July 6	July 13	Aug. 4	Aug. 11	" 29
Habenaria dilatata.	Apr. 25	May 30	May 29	June 12	July 30	Aug. 20
" hyperborea	" 25	" 20	June 5	" 10	" 1	Sept. 1
" psycodes ..	" 25	June 17	" 29	July 11	" 27	Aug. 30
Helianthemum						
grandiflorum	June 5	July 9		Aug. 5		
Hibiscus militaris..	May 18	Aug. 4	Aug. 18	Aug. 17	Sept. 30	Oct. 27
" Moscheutos	" 18	July 12	July 22	" 16	Aug. 31	Sept. 15
Hieraceum						
aurantiacum	" 13	Aug. 5	Aug. 16	" 15	Sept. 12	" 17
Houstonia caerulea	" 18	Apr. 18	May 9	June 8	June 20	" 27
Hydrophyllum						
Canadense	" 6	June 9	June 27	" 20	July 12	Nov. 13
" Virginianum		May 15	" 7	May 27	June 29	Dec. 2

HERBACEOUS PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Hymenocallis occidentalis	May 18	June 18	July 6	June 22	July 28	Oct. 3
Hypericum Ascyron	Apr. 26	" 30	" 13	July 29	Aug. 11	Nov. 5
" perforatum	May 30	" 25	" 22	" 31	" 16	Oct. 11
Hypoxis erecta....	" 3	May 6	June 28	" 10	" 19	Sept. 20
Iberis Pruiti.....	June 14	July 18	July 30	Aug. 7	" 16	Aug. 29
Iris cristata.....	May 1	May 6	May 18	May 15	June 5	Sept. 29
" hexagona.....	Apr. 10	" 15		" 30	" 27	" 11
" versicolor.....	May 15	" 24	Aug. 6	June 15	Aug. 30	Nov. 4
Jeffersonia diphylla	Apr. 25					
Jussiaea repens....	June 2	June 27	July 30	Aug. 5	" 29	Oct. 21
Lilium Canadense..	May 12	July 11	Aug. 6	" 2	" 20	Aug. 28
" " var. flavum...	" 11	" 5	July 25	July 29	" 16	" 30
" " Carolinianum	" 25	Aug. 18	Aug. 23	Aug. 27	Sept. 9	Oct. 1
" " Humboldtii..	" 9	June 29	July 13	July 12	Aug. 2	Aug. 29
" " pardalinum..	" 10	July 2	" 10	" 18	" 9	" 27
" " parvum.....	" 13	June 2	June 19	June 15	July 29	Oct. 5
" " superbum ...	" 11	July 14	Aug. 12	July 23	Aug. 28	Sept. 2
" " Washingtonianum	" 12	June 17	June 26	June 28	July 8	July 17
Lithospermum canescens	" 12	May 23	" 11	" 31	" 29	Sept. 5
Lobelia syphilitica.	" 23	Aug. 8	Sept. 2	Aug. 29	Oct. 10	Oct. 30
Lophanthus nepetoides	" 12	" 17		" 31	" 1	" 5
Lupinus perennis..	" 12	May 18	June 3	May 30	June 30	Sept. 7
Melilotus alba.....	" 10	June 16	July 18	July 7	Aug. 10	Oct. 29
Mertensia Virginica	" 12	Apr. 18	May 11	May 7	May 20	May 31
Mesembryanthemum pinnatifidum	" 20	June 1	June 15	June 13	June 25	Aug. 7
Mimulus ringens...	Apr. 23	" 24	July 7	July 18	Aug. 3	Oct. 7
Mitella diphylla ...	May 8	Apr. 29	May 12	May 14	May 25	June 11
Monarda didyma...	June 4	June 30	July 15	July 19	Aug. 17	Oct. 26
Muhlenbergia Mexicana	" 16	" 25	" 5	Aug. 29	" 11	Nov. 14
Nepeta Glechoma*.	May 2	May 3	May 20	June 15	July 12	Oct. 14
Nymphaea odorata.	Apr. 23	June 17	July 1	Aug. 29	Sept. 13	" 29
" " var. minor	May 1	July 6	" 9	" 31	" 11	" 15
Oakesia sessilifolia	Apr. 27	May 3	June 25	May 10	July 5	" 20
Oenothera biennis..	June 2	July 28	Aug. 5	Sept. 28	Oct. 9	Nov. 1
Orchis spectabilis..	May 3	May 6	May 16	May 26	May 31	July 30
Osmorrhiza Claytonii	May 4	May 13		May 23		
Oxalis stricta.....	" 13	June 8	June 29		July 9	Oct. 28
" Suksdorfii...	" 15	" 8	July 20	Aug. 12	Aug. 2	Aug. 19
" violacea	" 3	" 22	" 17	" 20	Sept. 14	Oct. 12
Panicum latifolium.	" 20	" 2	" 24	June 21	Aug. 14	Nov. 20
Papaver Alpinum..	June 16	" 24		July 24	July 26	Aug. 15
Penstemon laevigatus	" 1	" 22	" 15	" 13	Aug. 12	Nov. 9
" ovatus ...	May 20	July 11		" 28	" 15	" 15
Phlox divaricata...	" 1	May 6	June 1	May 21	June 20	" 17

HERBACEOUS PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Phlox pilosa.....	May 7	May 15	June 4	June 12	July 6	Nov. 29
Phryma Leptostachya	" 30	July 2	July 23	Aug. 1	Aug. 19	Oct. 1
Phytolacca decandra		June 24	June 2	" 24		Sept. 28
Pimpinella integerrima	" 1	May 3	" 5	June 1	June 29	
Pinguicula vulgaris	" 1	" 11	May 21	May 29	" 24	July 2
Plantago lanceolata*	" 13	June 15	July 13	July 3	Aug. 12	Oct. 27
Poa compressa....	" 28	" 3	June 18	June 30	July 19	" 29
Polemonium caeruleum	" 7	May 2	May 26	May 18	June 9	Sept. 25
" reptans...	" 16	" 3	June 6	" 26	" 28	
Polygonum Pennsylvanicum	" 12	" 25	July 27	" 31	Sept.29	Oct. 17
Polymnia Canadensis	" 28	June 30	" 21	Aug. 2	Aug. 29	" 30
Pontederia cordata.	June 28	July 12	Aug. 10	" 11	Sept. 7	" 22
Portulaca rostellata	" 9	June 24	July 3	July 22	Aug. 13	Sept. 26
Potentilla argentea	May 15	May 30	June 14	June 20	July 8	Aug. 16
Primula Mistassinica	" 1	Apr. 29	May 27	May 18	June 24	Sept. 1
Ranunculus acris*.	" 7	May 15	July 1	July 15	Aug. 30	Nov. 29
" sceleratus	" 27	July 11	" 16	" 24	" 12	Aug. 27
Rhexia Virginica...	" 28	" 18	Aug. 6	Aug. 26	" 30	Sept. 15
Ruellia ciliosa.....	" 23	" 21	" 19	" 14	Sept.18	Nov. 13
Rumex Acetosa....	" 25	June 2	June 17	June 19	July 5	" 3
" altissimus....	" 14	May 19	May 30	" 12	June 29	Sept. 27
" crispus.....	" 15	" 25	July 16	" 10	Aug. 20	" 9
" dentatus.....	" 14	June 3	June 27	" 19	July 21	Oct. 29
" bucephalophorus	" 15	May 23	" 7	" 13	Aug. 12	Sept. 17
" glomeratus...	" 9	" 20	" 10	" 13	July 20	Oct. 2
" hastatulus....	June 23	July 20	Aug. 4	Aug. 20	Aug. 31	Aug. 10
" occidentalis..	May 16	May 10	May 18	May 29	June 29	Sept. 28
" persicarioides	June 12	July 19	July 31	Aug. 16	Aug. 25	Oct. 17
" roseus.....	May 9	May 4	June 19	June 12	July 5	July 18
" salicifolius ...	" 17	" 20	" 2	" 10	June 28	Oct. 2
Saponaria officinalis	Apr. 23	June 20		Aug. 1	Aug. 16	Nov. 3
" Vaccaria.	May 12	" 9	June 20	June 29	July 13	July 13
Sanguinaria Canadensis	" 10	Apr. 4		Apr. 20		Aug. 5
Sarracenia flava ...		May 7		May 20	June 12	
" purpurea	" 2	" 24	July 12	June 12	July 4	Dec. 2
" rubra....	" 17	June 7	" 5	" 19		
Saxifraga Virginiensis		Apr. 18	May 10	May 10		Aug. 17
Scirpus lineatus...	" 14	May 29	June 30	June 13	" 11	Oct. 29
Scorpiurus vermiculata	" 7	" 12	May 16	May 30	May 30	Sept. 17

HERBACEOUS PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Scutellaria canescens	June 7	July 19	July 30	Aug. 20	Aug. 26	Oct. 27
" versicolor	May 12	June 21	" 12	July 16	" 30	" 6
Sedum Nevii.....	" 5	" 12	June 17	June 2	July 13	
Silene Pennsylvanica	Apr. 20	May 2	May 23	May 20	June 2	" 30
" Virginica.....	" 20	" 9	" 19	" 25	May 31	" 26
Sisyrinchium anceps	May 18	" 25	June 8			
Smilacina amplexicaulis		Apr. 5		Apr. 10		Aug. 17
" racemosa....	Apr. 20	" 4	May 11	May 7		" 29
" stellata.....	" 23	May 4		" 20		Oct. 31
Smilax glauca.....	" 29					
" hispida	" 29					
Solea concolor.....	" 23	June 1	July 2	July 29	Aug.20	Oct. 28
Sorghum halepense	May 6	Aug. 11	Aug. 29	Aug. 30	Oct. 12	Nov. 13
Steironema lanceolatum	" 30	July 5	July 23	July 19	Aug.27	Oct. 11
Streptopus amplexifolius	Apr. 27	May 6	June 20	May 18	July 2	Sept. 6
" roseus	" 27	" 4	May 12	" 15	May 23	Aug. 30
Symplocarpus foetidus	" 23	Mar.22	Apr. 1	Mar. 28	Apr. 12	Nov. 9
Thalictrum dioicum	May 6	Apr. 21	May 13	May 4	May 28	Oct. 29
" polygamum	" 7	June 16	June 26	July 12	Aug.20	" 20
Thaspium aureum..	" 13	May 25	" 30	June 14	June 2	Nov. 13
Trillium cernuum..	Apr. 27					
" erectum.....	May 5	Apr. 4	May 26	May 2		June 8
" erythrocarpum	" 2	May 7	July 10	" 20	Aug. 13	Aug. 22
" grandiflorum..	" 2	Apr. 17	June 20	" 10	July 12	Oct. 1
" recurvatum...	" 8	" 22	May 10	" 8	May 18	
" rivale.....	" 2	" 4		Apr. 9		May 23
" stylosum.....	Apr. 27	May 7		May 18		Sept. 11
Triosteum perfoliatum	May 11	May 30	June 12	June 15	June 22	Oct. 13
Tripsacum dactyloides	June 7	June 23	Aug. 19	July 18	Sept.30	Nov. 21
Uvularia grandiflora	May 3	Apr. 27	June 3	May 2	July 6	Sept. 20
" perfoliata .	Apr. 29					
Vancouveria hexandra	" 23	May 11	May 19	" 30	June 13	" 25
Veratrum Californicum	May 20					
Verbesina helianthoides	" 26	June 21	July 25	July 24	Aug.26	
Veronica Virginica	" 6	July 5	" 29	" 31	" 22	Nov. 20
Viola blanda	" 10	Apr. 23	May 28	May 17	June 26	
" Canadensis..	Apr. 18	May 1	" 31	" 25	Aug. 11	Oct. 31
" pedata	May 4	" 3	" 12	" 28	June 4	
" " var.bicolor	" 8	" 12	" 19	" 23		

HERBACEOUS PLANTS, 1892 — *Concluded.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Viola pubescens...		May 9	June 23		Aug. 9	Sept. 20
" rostrata.....	May 2	Apr. 28	" 24	May 15	Sept. 10	
" rotundifolia .	Apr. 23	May 9	May 19	June 29	July 13	Aug. 30
" striata	May 12	Apr. 23	June 3	May 19	June 30	Nov. 14
Zizia aurea.....		May 6	July 12	June 15	Aug. 22	
" cordata.....	" 12	" 23	" 17	" 10	Sept. 11	Oct. 29

WOODY PLANTS, 1892.

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Acer dasycarpum..	Apr. 16	Mar. 10	Apr. 27			
" platanoides†..	" 20					
" rubrum	" 18	" 31	" 30			
" saccharinum .	" 16	" 10	" 27			
" spicatum.....	" 28					
Aesculus flava.....	" 22	May 2				
" glabra.....	" 20	Apr. 29				
" Hippo-castanum*†	" 24	May 12				
" macrostachya	" 20	June 25				
" rubicunda ...	" 12	" 12				
Ailanthus glandulosa	May 3	" 26				
Alnus viridis.....	Apr. 25					
Amelanchier oligocarpa	May 1	Apr. 30	May 15	May 4	May 29	
Aralia nudicaulis..		May 16	May 30	June 13	July 17	Oct. 2
Aristolochia Serpentaria	May 4					
" Sipho.....	" 6					
Betula lutea.....	" 5					
Catalpa bignonioides	" 4	June 15				
Cercis Canadensis..	" 11	Apr. 24				
Cladrastis tinctoria	Apr. 19					
Clematis Fremonti.	May 7					
" Virginiana	" 8					
Cornus sericea.....	Apr. 23					
Dirca palustris....	May 5	Apr. 15		May 1		Aug. 10
Euonymus atropurpureus	Apr. 25					
Gymnocladus Canadensis	May 5					
Hydrangea arborescens	Apr. 25	June 19	June 30	July 27	July 27	Nov. 8

WOODY PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Ilex verticillata....	Apr. 29					
Lindera Benzoin...	" 25					
Magnolia						
acuminata..	May 20	May 7				
" conspicua..	Apr. 30	Apr. 4				
" cordata	May 2	May 7				
" Lenne.....	Apr. 30	Apr. 17				
" macrophylla	" 30	May 28				
" purpurea...	" 30	Apr. 17				
" speciosa....	May 2	" 22				
" stellata.....	Apr. 22	" 4				
" tripetala ...	" 29	May 26				
Menispermum						
Canadense	" 26	June 16	July 5	July 20	Aug. 9	Oct. 27
Myrica Gale.	" 25	" 12	" 2	" 7	July 30	Nov. 3
Philadelphus						
Lewisii	May 12					
Physocarpus						
opulifolius	Apr. 25					
Pinus Austriaca ...	May 12	May 12				
" inops	" 1	" 10				
" resinosa.....	" 11	" 10				
" rigida.....	" 9	" 9				
" sylvestris† ..	" 11	" 9				
Populus alba.....	Apr. 29	Apr. 6				
" grandidentata		Mar.30				
" monilifera ...	" 22	" 31				
" nigra var.						
pyramidalis		" 31				
Pyrus arbutifolia..		May 7	" 15	May 30	Aug. 28	" 12
Rhamnus alnifolia.	" 26	June 16	" 5	July 20	" 9	Oct. 27
Rhododendron						
Catawbiense	May 6	May 4		May 11		
" maximum...		" 13		" 21		
Rhus aromatica....	Apr. 7	Apr. 11	May 12	" 1	June 2	
" glabra.....	May 3	June 24		July 14		Nov. 10
" typhina.....	" 10					
Ribes Cynosbati...	Apr. 26					
" lacustre.....	" 29					
" prostratum ..	May 2	May 6	June 7	May 10	July 22	Sept. 12
" rubrum †....	Apr. 25					
Robinia hispida....	May 2	" 16				
" Pseudacacia†	Apr. 28	" 13				
" viscosa.....	May 4	" 18				
Rosa blanda.....	Apr. 25	" 24	Aug. 29	June 7	Sept.19	Oct. 4
" pisocarpa	" 25					
" setigera.....	" 23					
Rubus occidentalis.	" 30	" 26	July 1	" 2	July 18	" 11
" strigosus....		" 17	June 11	" 2	" 15	" 29
Salix balsamifera..	" 25	" 19	May 30	" 3	June 16	Nov. 5
" candida.....	" 26	" 30	June 7	" 23	July 12	Oct. 2
" myrtilloides ..	May 5	Apr. 19	May 18	May 12	May 2	

WOODY PLANTS, 1892 — *Continued.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Sambucus Canadensis	May 5	June 7	Aug. 17	June 30	Sept 22	Nov. 22
" racemosa..	" 10	Apr. 27	May 9	May 7	May 20	Oct. 19
Spiraea salicifolia..	Apr. 25	June 22	July 1	July 7	July 29	Nov. 1
" tomentosa.	" 5	July 9	" 19	Aug. 6	Aug. 17	
Staphylea trifolia..	" 20	Apr. 30	May 14	May 15	June 3	Sept. 4
Syringa vulgaris * †	Mar. 29	" 27				
Tilia Americana....	Apr. 22	June 18	June 24			
" argentea.....	" 30	" 25	July 1			
" heterophylla..	May 2	" 20	June 27			
" ulmifolia.....	" 4	" 28	July 4			
" vulgaris.....	" 2	" 13	June 17			
Ulmus Americana..	Apr. 25	Mar. 29	Apr. 18			
" campestris..	May 2	Apr. 6	May 4			
Vaccinium uliginosum	Apr. 29					
Viburnum acerifolium	" 28					
" dentatum ..	" 29					
" lantanoides	" 26	May 3	June 18	June 28	July 9	Nov. 11
" Lentago ...	" 26					
" opulifolium	" 25					
" pauciflorum	" 29					

WOODY PLANTS, 1893.

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Acer dasycarpum..	Apr. 6	Mar. 5	May 2	Mar. 18	May 13	Nov. 9
" platanoides† .		Apr. 5	Sept. 21	Apr. 15	Oct. 14	" 13
" rubrum	" 12	Mar. 31		" 5		" 13
" saccharinum..	" 17					" 13
Aesculus glabra....		Apr. 18	Oct. 14	May 5	Oct. 22	Oct. 30
" Hippocastanum*†	" 12	May 12	Sept. 28	" 22	" 14	Nov. 16
" macrostachya		June 24		July 17		" 15
" rubicunda ...		May 1	" 21	June 17	" 14	" 9
Ampelopsis quinquefolia	" 8	July 9	" 14	July 20	Nov. 3	" 12
Berberis vulgaris (1)	" 5	May 13		May 16		" 15
Carpinus Betulus (1)†	" 12	Apr. 12		Apr. 17		" 24
Castanea vesca (1).	May 12	June 24	Oct. 7	July 4	Oct. 18	" 15
Catalpa bignonioides	" 15	" 11	" 24	" 1		Oct. 31
Cornus florida.....		Apr. 29	Sept. 17	May 17	" 14	Nov. 15

WOODY PLANTS, 1893 — *Concluded.*

NAME OF PLANT.	First Leaf.	First Flower.	First Ripe Fruit.	Last Flower.	Last Fruit.	Last Leaf.
Euonymus atropurpureus	Apr. 10	May 31		June 25		Nov. 15
Fraxinus Americana	May 8	Apr. 14		Apr. 17		" 9
" excelsior †	" 10	" 14		" 17		" 24
Ginkgo biloba (2)..	Apr. 13		Oct. 24			" 15
Gleditschia triacanthos	" 28	May 20	Sept.26	May 28		" 9
Gymnocladus Canadensis	" 28					" 9
Juglans cinerea....	May 3	" 27		June 31		
" nigra.....	Apr. 4	" 17	Oct. 7	May 22	Nov. 1	Oct. 30
Larix Europaea....	May 4					Nov. 20
Lonicera tatarica..	" 6	" 25		June 12		" 20
Negundo aceroides.	Mar.22	Apr. 3		Apr. 8		" 9
Persica vulgaris....	Apr. 5	" 5		" 15	Sept.25	" 25
Populus alba.....	" 8	Mar.28		" 3		" 13
" monilifera.	" 12	" 31		" 3		" 13
" nigra var. pyramidalis	" 12	" 31		" 2		" 13
Prunus Cerasus....	" 8	Apr. 8		" 12		
" serotina....	" 6	May 11	July 24	May 16	Aug. 27	" 13
Pyrus baccata.....	Mar.24	Apr. 12		Apr. 28		" 24
" coronaria ...		May 2	Sept.22	May 10	Oct. 12	" 13
" Ioensis	Apr. 3	Apr. 28	" 24	" 8	" 18	" 17
" Malus†.....	" 8	" 12		Apr. 25		" 20
Quercus alba (1)...	May 3	" 21		" 10		" 24
" Robur (1).	" 1	May 1				" 24
" rubra.....	" 3	" 3				" 15
Ribes rubrum†.....	Apr. 2	Apr. 15	June 22			
Robinia hispida....	May 1	May 13	" 5			" 15
Robinia Pseudacacia†		May 17				Nov. 15
Syringa vulgaris*†.	Mar. 13	Apr. 14		May 8		" 13
Taxodium distichum	Apr. 12					" 28
Tilia Americana ...	" 19	June 22		June 25		Oct. 30
" vulgaris	" 12	" 8		" 14		" 30
Viburnum Opulus..	" 8	May 3		May 21		
Weigelia rosea (1).	" 10	" 5		June 10		Nov. 24

THE EMERGENCE OF PRONUBA FROM THE YUCCA CAPSULES.

BY J. C. WHITTEN.

Studies of the eastern Yucca Moth (Pronuba yuccasella), and its importance in yucca pollination, have, from time to time, been recorded in the Garden Reports.* Heretofore, a knowledge of the life history of this interesting insect has been incomplete in one detail, observations having left a break from the time when the larva ceases feeding in the capsule, until it is incased in its underground cocoon, where, the following spring, it is to change to the pupa state.

The past season, through suggestions of the Director of the Garden, steps were taken to ascertain the time and method of the passage of the insect from the capsule to the ground. Two plants of the common Yucca filamentosa were selected for observations. These yuccas bloomed about the last of June. On August 5th, perforations were seen, where a few of the larvae had left the capsules. To prevent other larvae from escaping unnoted, a bag was fastened closely around the scape of each plant, the top of the bag being held open by a large hoop, which surrounded the plant just below the seed pods. These bags were held in place by stakes driven into the ground, and insured catching any larvae that might drop from the pods. To prevent their crawling out of the bag, its upper edge was coated with tar.

Observations were regularly made morning and evening, from August 5th to August 12th. Up to the evening of the 10th, no larvae had made their appearance. The weather, meantime, was dry and hot. During the night

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* Pp. 99 to 158, pl. 34 to 43, Third Garden Report; pp. 181 to 225, pl. 20 to 23, Fourth Garden Report.

of the 10th it rained more or less constantly, and when the bags were examined, at eight o'clock the next morning, a larva was found in bag no. 1. It remained cloudy, with little or no rain, until nearly eleven o'clock, when a lively rain set in. An examination of both bags at this time showed that no more larvae had come out. About one o'clock, it cleared up somewhat and four more larvae were found in bag no. 1, and eighteen in bag no. 2. It rained frequently during the afternoon and following night. At five o'clock in the afternoon, four more larvae were in bag no. 2, and at eight o'clock the next morning, still eighteen more had dropped in the same bag. These were the last ones caught, though the bags were left in place until the seed pods split open. Two larvae were seen to leave the pods, and this was while it was raining. These dropped quickly down at the end of a silken thread.

These observations show, therefore, that it is during rainy weather, when the ground is softened and consequently easily penetrable, that the larvae make their escape from the capsules and enter the soil; and it is of interest to note that they do this either during the daytime or at night, and not exclusively toward the end of the night, as Professor Riley had predicted.* The use of a thread, supporting the larva in its descent, is in accordance with the prediction of Professor Riley,† who, since the preceding observations were communicated to him, expresses the opinion that the larvae may descend both by use of a thread and by crawling, as does the codlin of the apple.

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* Third Garden Report, 114.

† *l. c.* 114.

NOTES ON A LIST OF PLANTS COLLECTED IN SOUTHEASTERN MISSOURI IN 1893.

BY B. F. BUSH.

Being desirous of exploring the St. Francois River Valley and the country contiguous to it, I was led by Dr. Trelease to make a trip to Southeastern Missouri early in May, 1892, and the results were so gratifying that other visits were planned. But being engaged by the World's Fair Commission of Missouri to work up the smaller ligneous flora of the State, and also collect such arborescent species as their collector had failed to secure earlier in the season, I was for a time unable to make any investigations of the flora of this region. However, in the course of my work I was sent to Southeastern Missouri in October, and again in November, 1892, but without being able to make any collection to speak of. Early in April, 1893, I was again sent to this part of the State, and although I had only a part of one day, I collected my press full of plants; and later on in the same month, I was sent once more to this region, where I was for nearly a week, and this time I was able to collect more largely.

My duties on the World's Fair work kept me from visiting this region again until after July of last year, and I did not make another trip until about the middle of September.

I began examining the flora in St. Francois County, between Bismarck and Loughborough along the St. Francois river, and spent one day at that place. Nine days in all were spent examining the St. Francois River Valley and the country adjacent to it, and the appended list represents the duplicate material collected on this trip, and also a few things collected in April, the numbers used being those under which the specimens were distributed. As I was working for the interest of the Missouri Botan-

ical Garden only, I did not collect sets for distribution, but have since put up what duplicates I had left, in a few sets, at the suggestion of Dr. Trelease.

The result of the work is, that we now know that we have a Floridan and Georgian flora, which extends up the Mississippi Valley in a northwesterly direction to Southeastern Missouri, where it meets a Texan Flora, which extends southwestwards to Texas.

1. RANUNCULUS PUSILLUS Poir.
   Common in Dunklin and New Madrid counties. Sept.
2. CABOMBA CAROLINIANA Gray.
   Abundant in St. Francois and Varner rivers in Dunklin county. Sept.
3. ARGEMONE PLATYCERAS Link & Otto.
   Spontaneous in Dunklin county, where it seems to be perfectly at home. Sept.
4. CORYDALIS AUREA Willd.
   On sandy prairies in Dunklin and Mississippi counties. Sept.
5. CARDAMINE DOUGLASSII (Torr.) Britt.
   In rather dry ground in Cape Girardeau county. April. Had nearly ripe fruit while C. bulbosa was just coming out in flower.
6. LECHEA TENUIFOLIA Michx.
   Abundant in St. Francois county. Sept.
7. LECHEA TENUIFOLIA Michx.
   With the last.
8. STELLARIA LONGIFOLIA Muhl.
   In wet places in Cape Girardeau county. April.
9. ASCYRUM CRUX-ANDREAE L.
   Drier places in Dunklin and New Madrid counties, where it is common. Sept.
10. HYPERICUM PETIOLATUM Walt.
    Abundant in the swamps of Dunklin and New Madrid counties, where it is commonly found on floating logs and old stumps. Sept.

11. HYPERICUM VIRGINICUM L.

Not so common as the last, but found in Dunklin county in similar situations. Sept.

12. HYPERICUM DRUMMONDII (G. & H.) Torr. & Gray.

Common in Dunklin, Stoddard and St. Francois counties. Sept.

13. HYPERICUM GENTIANOIDES (L.) B. S. P.

Common in St. Francois county. Sept.

14. HIBISCUS LASIOCARPUS Cav.

Common in the swamps of New Madrid, Dunklin and Cape Girardeau counties. Sept.

15. SIDA ELLIOTTII Torr. & Gray.

Common on the sandy prairies of Stoddard and Dunklin counties. Sept.

16. LINUM VIRGINIANUM L.

Found only in St. Francois county. Sept.

17. BERCHEMIA VOLUBILIS DC.

Common throughout Dunklin, Butler and New Madrid counties. Sept.

18. CISSUS STANS Pers.

Common in deep swamps of Butler and New Madrid counties. Sept.

19. ACER RUBRUM L.

Common to all the country adjacent to the St. Francois river, in St. Francois, Wayne, Mississippi, Dunklin, Stoddard, Butler and New Madrid counties. Usually on higher ground than the next. Sept.

20. ACER RUBRUM DRUMMONDII (H. & A.) Sargent.

Common in the swamps of Dunklin, New Madrid, Mississippi, Stoddard, Scott and Cape Girardeau counties. Sept.

21. ACER SACCHARUM BARBATUM (Michx.) Trelease.

Only observed in St. Francois County, and represents the form called A. Rugelii by Pax. Sept.

22. CASSIA CHAMAECRISTA L.

Common throughout Dunklin, St. Francois, Wayne and New Madrid counties. Sept.

23. Cassia nictitans L.

Common in all but the last of the above counties. Sept.

24. Cassia occidentalis L.

Common on the sandy prairies of Dunklin county. Sept.

25. Cassia Tora L.

With the last, but more common. Sept.

26. Meibomia obtusa (Muhl.) Kuntze.

Common on the sandy prairies of Stoddard and Dunklin counties. Sept.

27. Meibomia ochroleuca (M. A. Curtis) Kuntze.

Occasional on the sandy prairies of Stoddard county. Sept.

28. Meibomia pauciflora (Nutt.) Kuntze.

Deep wooded swamps in New Madrid county. Sept.

29. Meibomia rigida (Elliott) Kuntze.

Common on the sandy prairies of Dunklin, Stoddard and St. Francois counties. Sept.

30. Gleditsia aquatica Marsh.

Common in the swamps of Dunklin county. Sept.

31. Lespedeza stuvei Nutt.

On the sandy prairies of Dunklin county. Sept.

32. Lespedeza repens (L.) Bart.

Found only in St. Francois and Stoddard counties. Sept.

33. Lespedeza Virginica (L.) Britton.

Sandy places in St. Francois and Dunklin counties. Sept.

34. Lespedeza striata Hook. & Arn.

Almost everywhere in Dunklin, Stoddard, St. Francois, Wayne and Butler counties. Sept.

35. Lespedeza Stuvei Nutt.

On the sandy prairies of Dunklin and Stoddard counties. Sept.

36. Rhynchosia latifolia Nutt.

In same county as the last, and in similar situations. Sept.

37. AGRIMONIA MOLLIS (T. & G.) Britton.

Found only in St. Francois county. Sept.

This and two or three other species have been passing for A. Eupatoria, but that species does not occur in the State that I am aware of.

38. FRAGARIA INDICA L.

Along the sandy margins of swamps in Dunklin county, where it is common. Sept.

39. ITEA VIRGINICA L.

Common in the swamps of Butler and Dunklin counties, usually growing on floating logs and old stumps. Sept.

40. CALLITRICHE HETEROPHYLLA Pursh.

In swamps and sloughs along the St. Francois River in Wayne and Dunklin counties. April.

41. PROSERPINACA PALUSTRIS L.

Common in the swamps of Dunklin, Butler and New Madrid counties. Sept.

42. RHEXIA MARIANA L.

On the sandy prairies of Dunklin county, in wet places. Sept.

43. ROTALA RAMOSIOR (L.) Koehne.

Wet places on sandy prairies in Dunklin county. Sept.

44. JUSSIAEA DECURRENS (Walt.) DC.

Very common in the swamps of Dunklin and New Madrid counties. Sept.

45. JUSSIAEA REPENS L.

Abundant in St. Francois and Varner rivers in Dunklin county. Sept. I doubt very much if this is the true repens of Asia.

46. LUDWIGIA CYLINDRICA Ell.

Common in wet places on sandy prairies in Dunklin county. Sept.

47. CICUTA MACULATA L.

Abundant on floating logs and stumps in the swamps of Dunklin county. Sept.

48. ERYNGIUM PROSTRATUM Nutt.

Common in wet places on the prairies of Dunklin county. Sept.

49. PANAX QUINQUEFOLIA L.

Occasional in Dunklin county, in rich ground. Sept.

50. CORNUS STRICTA Lam.

Common in the swamps of Dunklin and New Madrid counties. Sept.

51. DIODIA VIRGINIANA L.

Common on the margins of swamps in Dunklin county. Sept.

52. HOUSTONIA PATENS Ell.

Common on the sandy prairies of Dunklin county. April.

53. MITCHELLA REPENS L.

On the sandy margins of swamps in Dunklin and New Madrid counties. Sept.

54. SPERMACOCE GLABRA Michx.

Wet places on sandy prairies in Dunklin county. Sept.

55. ASTER CORDIFOLIUS L.

Sandy prairies of Dunklin county. Sept.

56. ASTER LATERIFLORUS (L.) Britton.

In drier ground in St. Francois and Dunklin counties. Sept.

57. ASTER DRUMMONDII Lindl.

Sandy prairies in Dunklin county. Sept.

58. ASTER DUMOSUS L.

With the last. Sept.

59. ASTER ERICOIDES VILLOSUS Torr & Gray.

Found only in St. Francois county. Sept.

60. ASTER PANICULATUS Lam.

Rich woods in Dunklin county. Sept.

61. ASTER PATENS GRACILIS Hook.

Rocky banks of the St. Francois River in St. Francois county. Sept.

62. ASTER SAGITTIFOLIUS Willd.

Along the St. Francois in St. Francois county. Sept.

63. ASTER UNDULATUS L.

On the sandy prairies of Dunklin county. Sept. The specimens do not seem to agree with eastern material of this species.

64. ASTER VIMINEUS Lam.

With the last, but more common. Sept.

65. CHRYSOPSIS MARIANA (L.) Nutt.

This and the next were abundant on the sandy prairies of Dunklin and Stoddard counties. Sept.

66. CHRYSOPSIS VILLOSA Nutt.

With the last but not so common. Sept.

67. COREOPSIS ARISTOSA Michx.

Found in one or two old cotton fields in Dunklin county. Sept.

68. CNICUS ALTISSIMUS DISCOLOR (Muhl.) Gray.

Mostly in old fields in Dunklin and Stoddard counties. Sept.

69. ELEPHANTOPUS CAROLINIANUS Willd.

Common throughout Dunklin, New Madrid, Wayne, Cape Girardeau, Mississippi, Butler and St. Francois counties. Sept. Specimens are from an inch to two feet high.

70. GNAPHALIUM OBTUSIFOLIUM L.

Collected in old fields in Dunklin county. Sept.

71. HELENIUM TENUIFOLIUM Nutt.

Common on the sandy prairies of Scott, Dunklin, Stoddard, Wayne, Bollinger, Cape Girardeau and Butler counties. Sept.

72. HELIANTHUS ATRORUBENS L.

Sandy prairies of Dunklin and Stoddard counties. Sept.

73. HELIANTHUS STRUMOSUS L.

On the prairies of Dunklin county. Sept.

74. HELIANTHUS PARVIFLORUS Bernh.

Common with the last in Dunklin county. Sept.

75. MIKANIA SCANDENS (L.) Willd.

Abundant in the swamps of Dunklin, New Madrid, Scott and Stoddard counties. Sept.

76. SOLIDAGO LEPTOCEPHALA Torr & Gray.

On the sandy prairies of Dunklin county. Sept.

77. SOLIDAGO NEGLECTA Torr. & Gray.

With the last. Sept.

78. SOLIDAGO NEMORALIS Ait.

With the last. Sept.

79. SOLIDAGO ODORA Ait.

With the last. Sept.

80. SOLIDAGO PILOSA Walt.

With the last. Sept.

81. SOLIDAGO RUGOSA Mill.

With the other species of Solidago, which were all collected on the sandy prairies of Dunklin county. Sept.

82. SPILANTHES REPENS Michx.

Wet places on the sandy prairies of Dunklin and New Madrid counties. Sept.

83. VERBESINA VIRGINICA L.

On the prairies of Dunklin county. Sept.

84. VERNONIA DRUMMONDII Shuttlw.

Collected in St. Francois county. Sept.

85. LOBELIA PUBERULA Michx.

On sandy prairies of Dunklin county. Sept.

86. STEIRONEMA RADICANS (Hook.) Gray.

In the swamps of Dunklin and New Madrid counties. Sept.

87. STYRAX AMERICANA Lam.

In a swamp in New Madrid county, but not common. Sept.

88. FORESTIERA ACUMINATA Poir.

All through the swamps of Dunklin and New Madrid counties. Sept.

89. FRAXINUS AMERICANA PROFUNDA.

Abundant in the swamps of Dunklin and New Madrid counties. Sept. So far as can be seen from his figure, the same as Wenzig's *F. platycarpa Floridana*, but it is possible that his figure is actually from young specimens of *platycarpa*. Differs from the usual form of *Americana* in the strong pubescence of the shoots, the large size of the leaves, and the very large fruit, the shaft of which is often strongly six-sided.

90. FRAXINUS VIRIDIS PUBESCENS Hitchc.

Common in the swamps of Dunklin county. Sept. I would suggest that the subspecific name ought to have been subpubescens, as there is some likelihood of confusing this with F. pubescens which I take to be a good species.

91. ASCLEPIAS PERENNIS Walt.

Common in the swamps of Butler, New Madrid and Dunklin counties. Sept.

92. POLYPREMUM PROCUMBENS L.

Abundant on the sandy prairies of Dunklin county. Sept.

93. HYDROLEA AFFINIS Gray.

Common in the swamps of Dunklin and New Madrid counties. Sept.

94. HELIOTROPIUM INDICUM L.

Throughout Dunklin, New Madrid, Bollinger and Cape Girardeau counties, in sandy ground. Sept.

95. CUSCUTA CUSPIDATA Engelm.

Abundant on the prairies of Dunklin and Stoddard counties, on various herbaceous plants. Sept.

96. CUSCUTA GRONOVII Willd.

Found only in St. Francois county. Sept.

97. CUSCUTA GRONOVII CALYPTRATA Engelm.

In a swamp in New Madrid county. Sept.

98. PHYSALIS OBSCURA Michx.

Sandy ground in Dunklin county. Sept.

99. GERARDIA SKINNERIANA Wood.

Abundant on the margins of swamps in Dunklin county. Sept. I have referred to this species the plants collected, although they seem more nearly to resemble G. Plukenetii.

100. HERPESTIS NIGRESCENS Benth.

Abundant on sandy prairies in Dunklin county. Sept. Our specimens are all bracteolate, thus differing from the generic characters as given in Flora of N. A.

101. DIANTHERA OVATA Walt.

In the swamps of Dunklin and New Madrid counties. Sept.

102. HEDEOMA PULEGIOIDES (L.) Pers.

Common in Dunklin county. Sept.

103. ISANTHUS BRACHIATUS (L.) B. S. P.

Collected in St. Francois county only. Sept.

104. LYCOPUS RUBELLUS Moench.

Common in the swamps of Dunklin county. Sept.

105. LYCOPUS RUBELLUS Moench.

With the last. Sept.

106. MENTHA SPICATA L.

Abundant in the swamps of Dunklin county. On floating logs and stumps. Sept.

107. MONARDA FISTULOSA MOLLIS Benth.

Sandy places in Dunklin county. Sept.

108. KOELLIA PILOSA (Nutt.) Kuntze.

On the sandy prairies of Dunklin county. Sept.

109. TRICHOSTEMA DICHOTOMUM L.

Sandy places in Dunklin county. Sept.

110. OXYBAPHUS ALBIDUS Sweet.

On the prairies of Stoddard county. Sept.

111. FROELICHIA FLORIDANA Moquin.

Abundant on the sandy prairies of Dunklin and Stoddard counties. Sept.

112. BRUNNICHIA CIRRHOSA Banks.

Common in the swamps of Dunklin and New Madrid counties. Sept.

113. POLYGONELLA ERICOIDES Gray.

Abundant on the sandy prairies of Dunklin county. Sept.

114. POLYGONUM PUNCTATUM Ell.

Wet places in Dunklin county. Sept.

115. POLYGONUM PUNCTATUM LEPTOSTACHYUM (Meisn.) Small.

Wet places in St. Francois county. Sept.

116. POLYGONUM DENSIFLORUM Meisn.

Abundant in St. Francois and Varner rivers in Dunklin county. Sept.

117. POLYGONUM PENNSYLVANICUM L.

Common on sandy banks of swamps in New Madrid county. Sept.

118. POLYGONUM SETACEUM Baldwin.

Wet places in Dunklin county, where it was very common. Sept.

119. POLYGONUM TENUE Michx.

Common on sandy ground in Dunklin, Stoddard and St. Francois counties. Sept.

120. ARISTOLOCHIA SERPENTARIA L.

In rich woods in Dunklin and New Madrid counties. Sept.

121. ACALYPHA GRACILENS A. Gray.

Dry ground in St. Francois county. Sept.

122. CROTON CAPITATUS Michx.

Sandy prairies of Dunklin county. Sept.

123. CROTON GLANDULOSUS L.

Sandy ground in Dunklin, Stoddard and St. Francois counties. Sept.

124. CROTONOPSIS LINEARIS Michx.

Same situation as the last and in same counties. Sept.

125. EUPHORBIA MACULATA L.

Sandy places in St. Francois county. Sept.

126. PHYLLANTHUS CAROLINENSIS Walt.

Common in sandy soil in Dunklin, New Madrid and St. Francois counties. Sept.

127. PLANERA AQUATICA Gmel.

Common in all the swamps of Dunklin and New Madrid counties. April.

128. LEITNERIA FLORIDANA Chapman.

Common to the big swamps of Butler and Dunklin counties. Sept. Judging from the material in the Engelmann Herbarium, this is Chapman's species, but our plant is much more robust, and the tree is considerably larger.

129. CERATOPHYLLUM DEMERSUM L.

In St. Francois River in Dunklin county. Sept.

130. TAXODIUM DISTICHUM Richard.

Throughout the swamps of Dunklin, Scott, Wayne, Bollinger, Cape Girardeau, New Madrid, Stoddard and Mississippi counties. April.

131. POGONIA TRIANTHOPHORA (Sw.) B. S. P.

In rich woods in Dunklin county. Sept.

132. SMILAX BONA-NOX L.

Common in Dunklin county. Sept.

133. COMMELINA HIRTELLA Vahl.

Low grounds in New Madrid county. Sept.

134. COMMELINA NUDIFLORA L.

Sandy places in Dunklin county. Sept.

135. SPARGANIUM SIMPLEX ANDROCLADUM Engelm.

Along the banks of Varner River, in Dunklin county. Sept.

136. ECHINODORUS RADICANS Engelm.

Deep swamps in Dunklin and New Madrid counties. Sept.

137. SAGITTARIA GRAMINEA PLATYPHYLLA Mich.

Sandy banks of swamps in Dunklin county. Sept.

138. CAREX GRANDIS Bailey.

Growing with Echinodorus radicans, and in same counties. Sept.

139. CYPERUS ARISTATUS Rottb.

Sandy ground in Dunklin county. Sept.

140. CYPERUS BALDWINII Torr.

With the last. Sept.

141. CYPERUS COMPRESSUS L.
Sandy places in Butler and Dunklin counties. Sept.
142. CYPERUS FILICULMIS Vahl
Sandy prairies of Dunklin and Stoddard counties. Sept.
143. CYPERUS DIANDRUS Torr.
Sandy places in Dunklin county. Sept.
144. ELEOCHARIS COMPRESSA Sulliv.
Wet places in Mississippi county. April.
145. ELEOCHARIS PALUSTRIS (L.) R. & S.
Swamps of Cape Girardeau county. April.
146. ELEOCHARIS TENUIS (Willd.) Schult.
Wet prairies in Dunklin county. April.
147. FIMBRISTYLIS AUTUMNALIS (L.) R. & S.
Common in sandy ground in Dunklin, New Madrid and St. Francois counties. Sept.
148. FIMBRISTYLIS CAPILLARIS (L.) Gray.
Sandy places in Dunklin county. Sept.
149. FIMBRISTYLIS CONGESTA Torr.
Common along the sandy banks of the St. Francois River in Dunklin county. Sept.
150. FIMBRISTYLIS DIPHYLLA Vahl.
Sandy ground in Dunklin county. Sept.
151. KYLLINGIA PUMILA Michx.
Abundant in sandy ground throughout Dunklin and New Madrid counties. Sept.
152. AGROSTIS ALBA L.
Collected in St. Francois and Dunklin counties. Sept.
153. ANDROPOGON ARGENTEUS Ell.
Sandy prairies of Dunklin county. Sept.
154. ARISTIDA BASIRAMEA Engelm.
Found only in St. Francois county. Sept.
155. ARISTIDA DICHOTOMA Michx.
Common in Dunklin and St. Francois counties in sandy ground. Sept.
156. ARISTIDA GRACILIS Ell.
With the last, and in same counties. Sept.

157. ARISTIDA OLIGANTHA Michx.

Only found in St. Francois county. Sept.

158. ARISTIDA PURPURASCENS Poir.

Sandy prairies of Dunklin and Stoddard counties. Sept.

159. ARISTIDA RAMOSISSIMA Engelm.

Common in sandy ground in Dunklin and St. Francois counties. Sept.

160. ERIANTHUS CONTORTUS Ell.

Sandy prairies of Dunklin county. Sept. Culms tall, commonly from twelve to sixteen feet high.

161. LEERSIA LENTICULARIS Michx.

Abundant in the swamps of Dunklin and New Madrid counties. Sept.

162. LEERSIA ORYZOIDES (L.) Poll.

Common in swamps in Dunklin county. Sept.

163. LEPTOCHLOA MUCRONATA Kunth.

Sandy prairies of Dunklin county. Sept.

164. PANICUM AGROSTOIDES Muhl.

Abundant in swamps of New Madrid and Dunklin counties. Sept.

165. PANICUM ANCEPS Michx.

Common in sandy ground in Dunklin and St. Francois counties. Sept.

166. PANICUM AUTUMNALE Bosc.

Common on the sandy prairies of Dunklin county. Sept.

167. PANICUM CAPILLARE CAMPESTRE Gattinger.

Sandy ground in St. Francois county. Sept.

168. PANICUM FILIFORME L.

Abundant in Dunklin, and tolerably common in St. Francois county. Sept.

169. PANICUM HIANS Ell.

Common along the sandy banks of the St. Francois River in Dunklin county. Sept.

170. PANICUM MICROCARPON Muhl.

Sandy ridges in Dunklin county. Sept.

171. PANICUM SANGUINALE, L.
Wet banks of the St. Francois river, in Dunklin county. Sept.

172. PANICUM XANTHOPHYSUM Gray.
Collected only in Dunklin county. Sept.

173. PASPALUM FLUITANS Kunth.
Abundant in the swamps of New Madrid and Dunklin counties. Sept.

174. PASPALUM LAEVE Michx.
Prairies of Dunklin county. Sept.

175. PASPALUM LAEVE ANGUSTIFOLIUM (Le Conte) Vasey.
Sandy ridges in Dunklin county. Sept.

176. PASPALUM WALTERIANUM Schultes.
Sandy prairies of Dunklin county. Sept.

177. SPOROBOLUS MINOR Vasey.
On the prairies of Dunklin county. Sept.

178. SPOROBOLUS VAGINAEFLORUS (Torr.) Vasey.
With the last but more common. Sept.

179. TRIODIA PURPUREA Hack.
Prairies of Dunklin county. Sept.

180. BOTRYCHIUM TERNATUM (Thunb.) Swartz.
In the swamps of Dunklin, New Madrid and Butler counties. Sept.

NOTES AND OBSERVATIONS.

BY WILLIAM TRELEASE.

1. PACHIRA SP.

In the collection of house plants at the Garden occur several trees about ten feet high, raised from seed obtained some sixteen years ago from Haage & Schmidt as *Carolinea alba*. These trees, with glossy palmate leaves, and a trunk conspicuously dilated at base, are quite decorative during the summer and early winter, but lose their foliage toward spring, their new leaves appearing in May. Every few years they flower shortly after the new leaves develop, and their fruit matures almost invariably.

The alternate leaves are dark green and glossy above, paler and dull beneath, digitate, with 3 to mostly 7 elliptical mucronate entire leaflets as much as 8 inches long with narrowly margined extremely short stalks. The common petiole, about as long as the leaflets, is thickened at base, and, like the very thick midribs, at first sparingly stellate pubescent, ultimately becoming glabrous, like the rest of the leaf.

The flowers usually open in pairs, and are solitary on stout slightly scurfy peduncles less than an inch long. Before expansion the buds are narrow and fusiform, recalling somewhat a very stout Catalpa capsule. They open at night and are fragrant, but the showy white androecium and greenish corolla fall before the middle of the next morning.

At the top of the pedicel six somewhat sunken elliptical yellow glands secrete nectar freely.

The calyx is cylindrical, about half an inch in diameter and an inch long, slightly and irregularly 5-lobed at top,

very sparingly rusty stellate, green, marked with minute pale dots.

The five petals are oblong, half an inch wide and as much as 7 in. long, whitish green with a shade of chocolate, and microscopically stellate pubescent, the hairs of the outer side being browner than those within, which give a satiny appearance to this side of the petals. On opening, the petals become coiled backwards and expose the pure white stamens as the showy part of the flower.

The androecium is about 6 inches long, with a thick corrugated tube 2 in. long, parted half an inch above the base into ten sets of about eight filaments each, which fork near the middle — each arm ending in a single anther cell. The anthers are oblong, versatile but nearly erect, and deep yellow, like the pollen. The ovary is conical, tomentose, 5-celled, and tapers into the slender white style, which about equals the stamens and is divided at apex into five short linear yellow stigmas.

The ovoid fruit becomes about 2 x 3 inches, and breaks into five valves, each carrying a septum on its middle, and leaving as many rows of about five seeds each attached to an axile 5-winged columella. This, like the inside of the valves, is densely white tomentose, while the seeds are glabrous, brown, with a series of somewhat anastomosing elevated white bands radiating from the hilum and meeting over the apex of the seed.

Martius, in volume i. of the Flora Brasiliensis, gives descriptions of the species of Pachira or Carolinea recognized as occurring in Brazil. In his General History of the Dichlamydeous Plants, Don characterizes all of the species recognized in 1831; and Spach, in Hist. Nat. des Végétaux, iii. 423, also treats of the genus in 1834, since which time no general account appears to have been written, though a number of plates have been published. The descriptions as a rule are incomplete in one or other important respect, so that it is impossible to name a specimen by them with certainty; but the number, apex, and degree of

pubescence of the leaflets, the degree of persistence of the leaves, the form of the calyx and the presence or absence of glands at its base, the color of the petals and stamens, the number of groups of filaments and the form of the anthers, and the presence or absence of hairs at the base of the style and on the seeds, all appear to afford characters by which species may be recognized, when they shall have been brought together. Unfortunately, herbarium material is rare and as a rule poor, few comparative field studies have been made, and no complete collections occur in conservatories, so far as I can learn. Some difference of opinion also exists as to the limitation of this and related genera.

If the characters given by Don are reliable, our plant is pretty certainly excluded from all of the species described by him, excepting *P. affinis*, the leaves of which are unknown (hence presumably absent at the time of flowering), while the peduncle appears to be longer than in our plant, and the petals erect, — neither of which characters need of necessity exclude our plant; but several important points are not mentioned in the description, so that I should hesitate either to call it *affinis* or to venture on a new name for it.

The five species which have been most cultivated may be separated by the following key, the names employed being those of the Index Kewensis, i. 442, though a strict investigation of the synonymy will suggest the propriety of certain changes.

* Stamen tube divided into five clusters: petals white or greenish.
Calyx very brown pubescent: glands present: stamens white: style white (or reddish?) ..... ***P. alba.***
Less rusty: no glands: style red.
Stamens creamy white ..... ***P. stenopetala.***
Stamens green below, red above ..... ***P. minor.***

** Stamen tube divided into ten clusters.
Corolla and style red: no glands: stamens white, or yellow at base ..... ***P. insignis.***
Corolla green and white: glands present: stamens and style white ..... ***P. sp.*** (plate 27).

*** Stamen tube divided into about fifteen clusters.
Corolla green and white: glands present: stamens and style yellow or white below, red above.....*P. aquatica.*

Explanation of plate 27. Fig. 1, flowering branch of *Pachira* species, half size; fig. 2, calyx, natural size; fig. 3, one cluster of stamens, natural size; fig. 4, anther, enlarged; fig. 5, seed, natural size.

2. Crassula quadrifida baker.*

This pretty, partly shrubby species, which, as Mr. Baker has pointed out, is quite exceptional in the genus Crassula by its constantly tetramerous flowers, has this year developed in the greenhouse a proliferous habit, forming numerous small rosettes of leaves in the otherwise normal inflorescence. The leaves of these clusters, except for their smaller size, are similar to those of the stem, and quite like those which are frequently clustered in the lower axils. Like the stem leaves they are conspicuously pitted.

The appearance of such a proliferous plant, and the details of its inflorescence, are well shown in plate 28 and the accompanying engraving.

* Baker, Refugium Botanicum (1873), pl. 298; Nicholson, Dictionary, Div. 2, 392.

3. COTYLEDON ORBICULATA L.*

The accompanying plate of what seems to be a form of this species is from living material received from Mr. C. R. Orcutt.

Cotyledon orbiculata is one of the representatives of the true Cotyledons of Africa, characterized by having the flowers on the numerical plan of 5, with a strongly gamopetalous corolla much longer than the calyx and with recurved lobes, and ten stamens inserted low in its throat. It is said to have been introduced into Europe in 1690, but, like many of the old fashioned succulents of decorative value, it is more frequently found in the hands of amateurs than dealers. It is a perennial shrub with a fleshy stem about three-quarters of an inch thick, and a span or two high, bearing large half elliptical leaf scars each marked by three rather large bundle scars, and a tuft of about four pairs of ascending spatulate entire shortly acuminate very fleshy leaves about 3 inches long, more or less closely dotted with corky points, the margins of the leaves being frequently somewhat rolled backwards. The upper part of the stem, the leaves and the inflorescence, are densely coated with white.

The flowers are borne on a stout naked peduncle about a span high, bearing a few caducous bracts, and subdichotomously branched above, the branches recurved and the ultimate peduncles, which are somewhat over a half inch long, pendent, so that the flowers hang nearly vertically. The calyx is short, with deltoid subacuminate segments about an eighth of an inch long, more or less tinged with red. The corolla is about an inch long when fully expanded, the recurved lobes being about half an inch in length, and is of a delicate flesh color shaded at times with darker red or

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* Linnaeus, Species Plantarum, 1753, 429; DC. Plantes Grasses, ii. pl. 76; Curt. Bot. Mag. ix. pl. 321; Don, Hist. Dichlamyd. Plants, iii. 109.

light green, one margin of each segment being nearly white on the back, while the inner face of all is more yellow in tint. The lower half of the broad tube is obtusely 5-sided, and the tube is widest at about the middle.

While the stamens are all inserted on the lower part of the corolla tube, those opposite the lobes have their filaments broadly dilated at this point, below which they appear as mere lines on the inner side of the corolla, while the alternate ones are compressed from the sides above their insertion, below which they extend to the receptacle as prominent ridges closely applied to the grooves which separate the five pistils. At their insertion, the filaments are strongly bearded. On the back of each pistil, near its base, is a yellow cup-shaped nectary, forming a pocket covered by the fleecy nectar guard, and separated from its fellows by the decurrent filament ridges already described. All of the filaments converge to the center of the flower just above their insertion, where they lie closely applied to the pistils, with which they protrude for a short distance, their ends being slightly divergent, so as to remove the thin cordate anthers a short distance from the minute terminal green stigmas. These become moist and receptive only after the anthers have shed their pollen, thus insuring a probability of cross-fertilization by aid of visitors attracted by the nectar secreted in the pockets on the backs of the pistils and protected by the tufts of hairs at the base of the stamens.

An interesting feature of the stamens is the changes which the anthers undergo during anthesis. When the corolla begins to unfold, they are narrowly oblong, the connective tipped with a small glossy gland; but in dehiscing they contract to a broad heart shape, expelling the pollen in long worm-like threads which are held by one end until brushed away.

The form here figured possesses somewhat longer leaves with more recurved margins than are shown in the illustrations referred to, and appears to stand between the varieties

obovata and *oblonga* of the Prodromus. It is closely related to *C. coruscans* Haworth, as figured by Sims in the Botanical Magazine, lii. pl. 2601, but the latter species is characterized by thick margined channeled leaves, while those of *orbiculata* are rather acute on the margin, the recurving of which is not sufficient to render them channeled.

Explanation of plate 29.— Fig. 1, habit of *Cotyledon orbiculata*, half size; fig. 2, leaf, natural size; fig. 3, flower, and fig. 4, opened flower, natural size; fig. 5, base of pistil with nectar gland, and longitudinal section of pistil and gland, × 2; fig. 6, young and old stamens, × 2.

4. Cucumis Melo Dudaim (L.).*

Through the Southern States a small melon is frequent in melon patches where volunteer plants are almost certain to appear each year among the musk melons, and the opinion seems to be quite prevalent that the vines, which resemble those of the ordinary melon, originate from degenerate seeds of the latter.

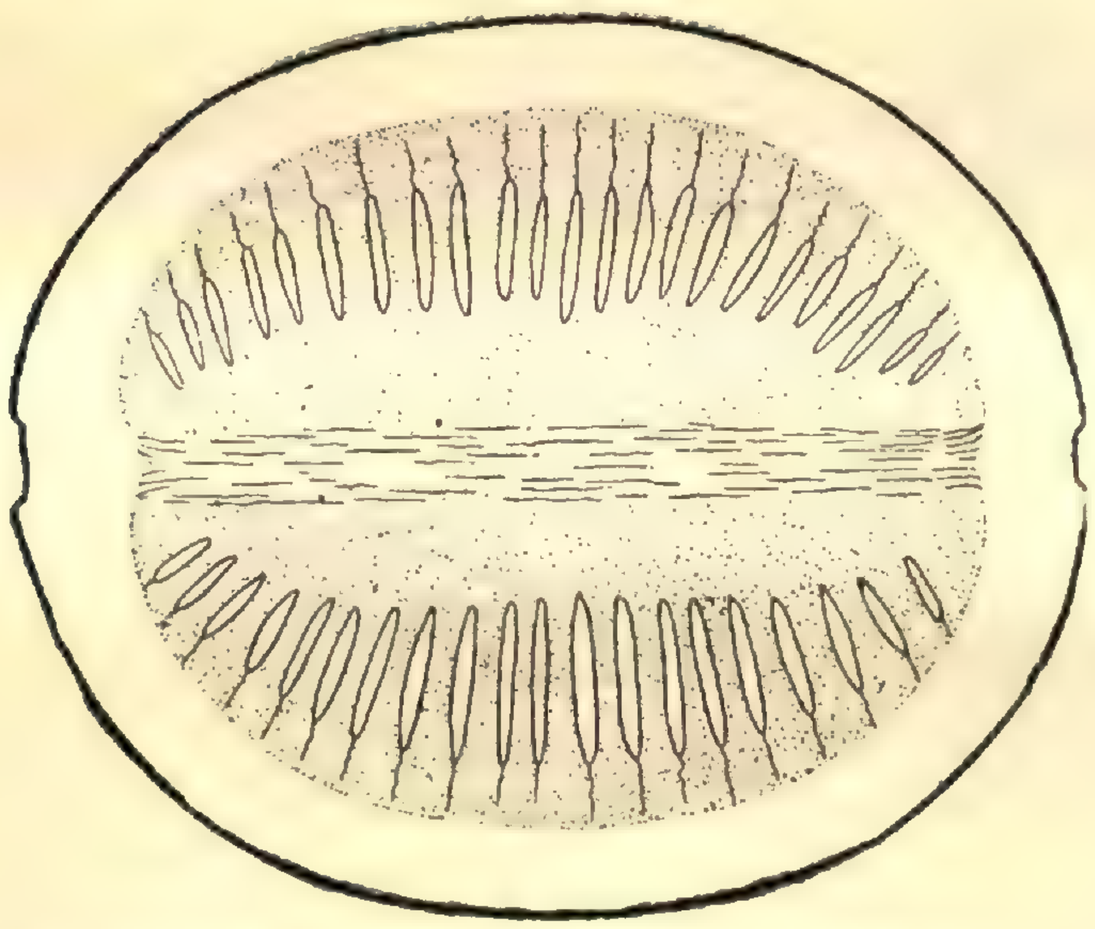
At first very dark green, and quite destitute of grooves, but with about ten longitudinal stripes and numerous irregular spots of lighter green, — then resembling a diminutive watermelon, — the fruit, which varies in size from that of an apricot to that of an orange, changes to a deep orange or maroon at maturity, and the paler stripes and blotches then assume a lemon yellow color. Though not at all grooved, it possesses the firm wall and central fibrous seed mass of the musk melons, but is gelatinous toward the center instead of becoming hollow as is usual with the latter; and when ripe assumes an unusually pronounced cantaloup odor.

All through the South these melons are known as "pomegranates," though they are in every way unlike the true pomegranate, — the fruit of the shrubby *Punica*

* Cucumis Melo Dudaim Naudin, Ann. Sc. Nat. 4 Ser. xi. (1859), 69. Pailleux and Bois, Potager d' un Curieux, 342. C. Dudaim Linn. Sp. Plant. ii. 1011. *C. Melo* Cogniaux, Monogr. Phan. iii. 484.— Synonymy in Naudin and Cogniaux.

Granatum, which is cultivated to some extent in the Gulf States. The same name has also accompanied them into the North and West as far as Missouri and Kansas, at least. Elsewhere they are said to be cultivated for ornament to a certain extent under the name of mock oranges, though they differ greatly from the gourd which is similarly named.

This melon is evidently the Melon Dudaim of French writers, and it is otherwise known as Concombre Dudaim, Queen Anne's pocket melon, melon de senteur, citrouille odorante, melon des Canaries, pomme de Brahma, and



SECTION OF DUDAIM MELON. (Natural Size.)

pomme de Grenade, — the latter corresponding to its popular American name.

Notwithstanding its smooth surface, small size, and gelatinous heart, the Dudaim is to be classed among the musk melons, of which there are a great many forms of very dissimilar appearance, several of which, including the present, have been named as distinct species.

The Dudaim melon is worthy of general cultivation as a climber because of the beauty of its fruits, which in this respect equal the finer gourds. They are also very attractive additions to a dessert piece of fruit, and their value for this purpose is increased by the highly developed melon

odor that they exhale when perfectly ripe, though to some persons this odor is disagreeable because of its intensity. As a table fruit, however, the melon is almost worthless, for though it is somewhat eaten when over-ripe, it is neither sweet nor of pleasant flavor. At best it is made the basis of a dessert by the use of sugar and wine to impart to it the sweetness and flavor which it naturally lacks. It is also capable of use in preserves, and forms the basis of the smallest of the stuffed mangoes,—a name which is no more appropriate to it than those of pomegranate and mock orange.

Related to the Dudaim, but rather to be regarded as an undeveloped netted melon, is the other form of the musk melon here shown, which is likewise destitute of longitudinal grooves, and possesses a jelly-like pulp about the seeds. This appears to be cultivated more or less extensively under the names of mango and vegetable peach, mainly for use in pickling, preserving, and jellies, though when fully ripe it is more palatable than the Dudaim, and capable of use on the table, if sliced with a liberal allowance of sugar and a little lemon or other flavoring substance. Unlike the Dudaim, it is covered with slightly elevated gray lines, generally distinct from one another, but suggestive of the more pronounced ridges of the netted varieties of cantaloup; but it possesses the same powerful fragrance at maturity, when it assumes a uniform light lemon color.

Explanation of plate 30.— Fig. 1, Dish of Dudaim Melons, half size; fig. 2, Preserving Melon, two-thirds natural size.

5. TILLANDSIA UTRICULATA L.*

Specimens of this Tillandsia were received in February, 1893, from W. T. Swingle and T. Holm, Mr. Swingle

* Linnaeus, Species Plantarum (1753), i. 286, with earlier references; Willd. Sp. ii. 11; Lamarck, Encycl. i. 617; Leconte, Ann. N. Y. Lyceum, 1826, ii. 129; Roem. & Schultes, Syst. vii. 1220; Chapm. Fl. S. U. S. 471; Baker, Journ. Bot. 1888, xxvi. 144, and Handbook Bromel. 229; Garber,

reporting it as very common on trees along the banks of the St. John's river and its tributaries, the cup formed by the imbricated leaves being filled with water. Mention was also made of the fact that the flowers were cream colored, in contrast with the usual purple of the genus. This specimen, which had already begun to send up a scape, flowered at the Garden in the early part of June, and furnished the material for the accompanying plate.

Tillandsia utriculata was one of the plants to attract the attention of earlier botanical explorers of the West Indian region, as is evident from the citations of Linnaeus under his description in the Species Plantarum. Bartram, writing in 1791, mentions it under the name of *T. lingulata* as a very large flourishing plant growing on the branches of trees, especially live oak, and greatly resembling, at some distance, a well-grown plant of the pine apple. He adds that "the large deep green leaves are placed in an imbricated order, and ascendant; but their extremities are reflex, their bases gibbous and hollowed, like a ladle, and capable of containing near a pint of water." Mr. Baker, in his classical revision of the large genus Tillandsia, places this species in Koch's subgenus Cyathophora, characterized by the rosulate leaves forming a cup, the inflorescence not distichous, the petal blade lingulate, with the claw scaleless, and long style and stamens. Of this group, *utriculata* is the only species possessing a large loose panicle. According to Baker it most nearly resembles *T. flexuosa*, from which it differs in its non-distichous spikes. Its distribution appears to be through southern Florida, the Bahamas and West Indies, Trinidad and Venezuela.*

T. utriculata is less densely scurfy than many of its con-

Bot. Gaz. ii. 7. *T. lingulata*, Bartram, Travels, 59, and French translation, i. 122. *T. Nuttallii*, Roem. & Sch. *l. c.* *T. Bartrami*, Nutt. Sill. Journ. (2) v. 292. *T. flexuosa*, var. *pallida*, Lindl. Bot. Reg. pl. 749. *Platystachys utriculata*, Beer, Bromel. 266. *P. Ehrenbergii*, Koch. *Allardtia Potockii*, Antoine, Oesterr. Bot. Zeitschr. 1878, 56. *Vriesia ramosa*, Beer. — The bibliography chiefly from Baker.

* Baker, *l. c.*; Hitchcock, Fourth Garden Rept. 135, 169.

geners, the deep green glossy leaf-surface acquiring a glaucous tint from the sparse scales. The whitish flower stalk is about equal in length to the leaves, and sheathed at intervals of about an inch by closely appressed bracts of a deep green. The panicle is about as long as the scape, with ascending branches a span long, the rachis flattened above each axil, and the subtending bract wrapped about the branch. The calyx is deep green, and each is closely encircled by a glossy bract of nearly equal length and similar color, just about equaling the pale internode. The expanded corolla is about double the length of the calyx, white with a slight creaminess, and somewhat waxen in appearance, cylindrical with perfectly erect lobes, opening only for a short distance on one side to form a slit through which the straight white filaments with yellow anthers and white style with green stigma protrude for about a quarter of an inch.

Explanation of plate 31. Fig. 1, flowering plant of *Tillandsia utriculata*, one-sixth natural size; fig. 2, branch of panicle, natural size; fig. 3, flower, × 2; fig. 4, flower with calyx opened, natural size; fig. 5, petal, natural size; fig. 6, cross-section of ovary, × 10; fig. 7, stigmas, × 3.

6. AGAVE PARVIFLORA TORREY.*

This charming little Agave, the smallest of the genus, was collected on the original Mexican boundary survey, by Dr. Schott, in the Sierras of southern Arizona, and characterized by Professor Torrey in the Botany of the Boundary Survey. Since that time, so far as I can learn, it has not been collected, although what purports to be this species is in cultivation in Europe; and the only material in the Engelmann herbarium is a portion of the original Schott specimen. In the latter part of July, 1892, Professor

* Bot. Mex. Bound. 214; Engelmann, Transactions St. Louis Academy, iii. 306, and Collected Writings, 307; Baker, Gardeners' Chronicle, 1877, n. s. vii. 303, and Amaryllideae, 166; Hemsley, Biologia Cent. Amer. iii. 347.

J. W. Toumey, of the University of Arizona, while exploring the Pinal Mountains, in southern Arizona, rediscovered the species and contributed to the herbarium of the Garden fruiting specimens, from which ripe seeds were obtained for germination.

The most striking feature of the Agave, which is well described by both Torrey and Engelmann, is the combination of two of the customary marginal characters of the leaves, for the dilated base is provided with short teeth pointing upward, while on the fleshy part of the leaf the margin is furnished with coarse white fibers, similar to those of *Schottii*, near which the present species is properly placed. It is, as Dr. Engelmann has stated, the only known species of the genus which combines these two characters.

The specimens collected by Professor Toumey, while they cannot be referred elsewhere than to *parviflora*, differ from the Schott material of the latter in the Engelmann herbarium in that the leaves are more concave, whereas in the Schott specimens the upper face is almost flat; and in having the capsules somewhat conically pointed above, and green, whereas in the Schott specimens they are more nearly globose, and delicately glaucous; but I take this difference to depend only upon the age of the specimens.

Explanation of plate 32.— Fig. 1, vegetating plant of *Agave parviflora*, natural size; fig. 2, leaf, natural size; fig. 3, portion of fruiting spike, natural size; fig. 5, seed, × 2, — all from Professor Toumey's material. Fig. 4, capsule, natural size; fig. 6, leaf, natural size; fig. 7, flowers, natural size; fig. 8, seed, × 2, — all from Schott specimens in the Engelmann herbarium.

7. Yucca Guatemalensis Baker.*

In the Fourth Garden Report, the unripe fruit of this species is described on page 184, and figured on plate 19.

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* Baker, Refugium Botanicum, 1872, v. pl. 313, Journal Linn. Soc. Bot. xviii. 222; Engelmann, Trans. St. Louis Acad. iii. 38, and Collected Writings, 289; Watson, Proc. Amer. Acad. xiv. 251; Trelease, Detail Illus-

The plant with its developing fruits was allowed to stand in the open air from the time of fertilization until the autumn of 1892, when it was removed to the succulent house and given the usual cool house treatment through the succeeding winter, but it was not until the middle of June, 1893, that the fruit ripened. This proceeded quite rapidly after it began, the base of each fruit softening first, and the remainder soon becoming very mellow, of a yellowish green color, sweetish and with a little bitterness, but without any other definable odor or flavor, in these respects agreeing with the fruit of *baccata* and *valida*, but differing from the dark fruits of *aloifolia*, which Mr. Burbidge has aptly characterized as resembling in flavor a mixture of black currant jam and quinine. As in the two species first named, the fruit falls early and the ripe seeds are surrounded by a thin but hard and papery core, within which they rattle when the fruit is shaken, while *aloifolia* is quite destitute of such a core, and far more persistent on the pedicel.

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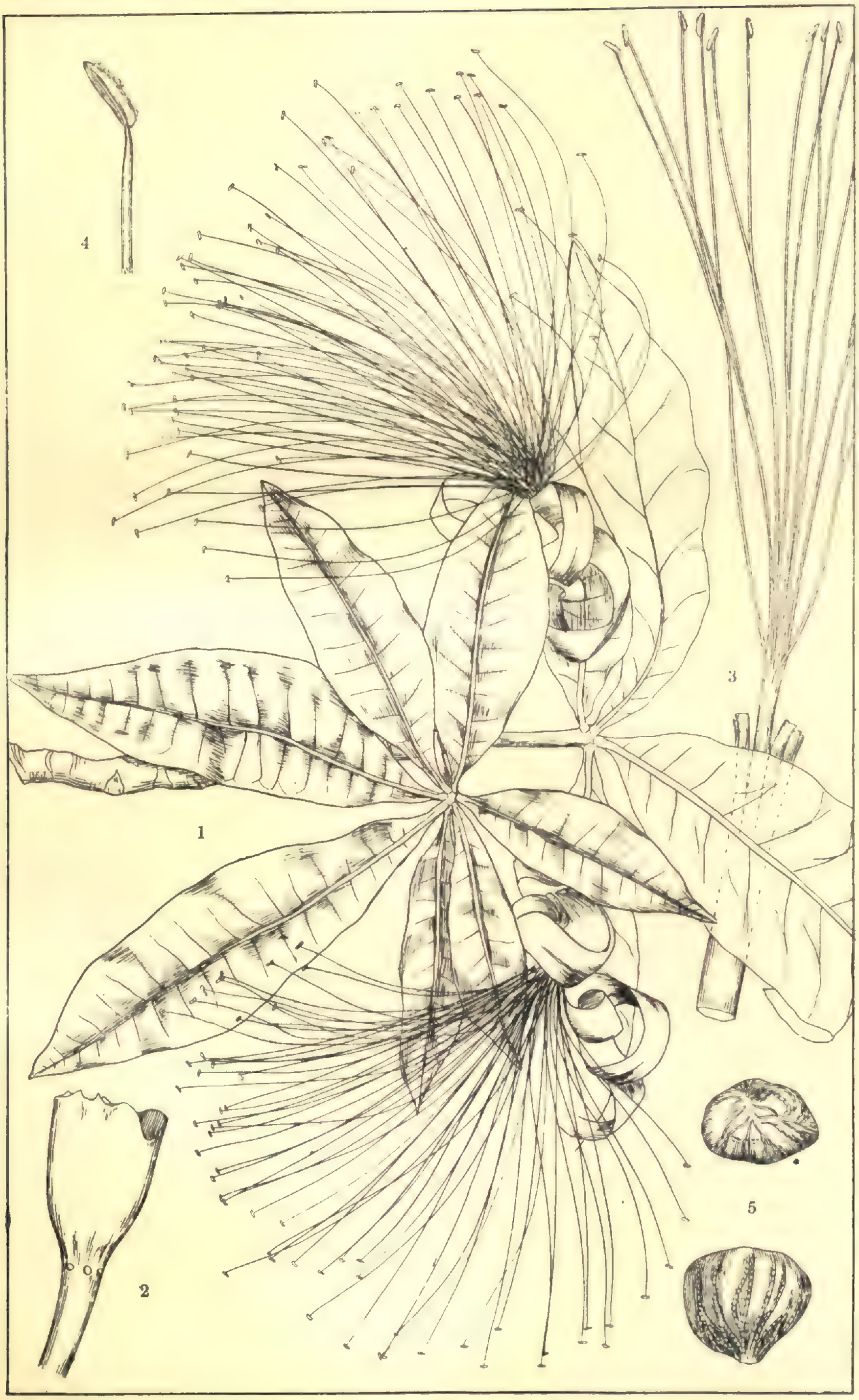
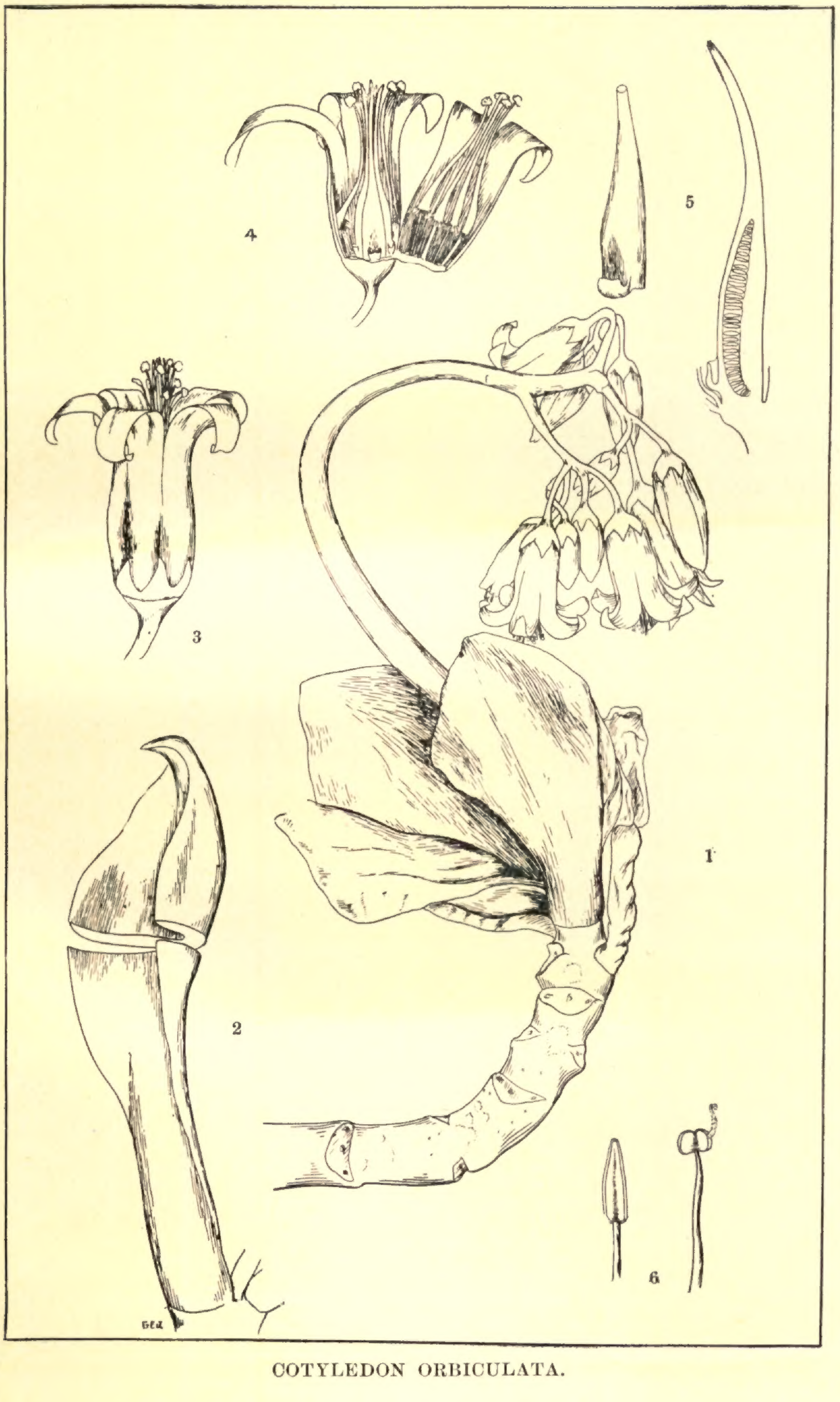
trations of Yucca, 162, and Further Studies of Yuccas and their Pollination, 184, pl. 1, 2 and 19.



PACHIRA, SP.

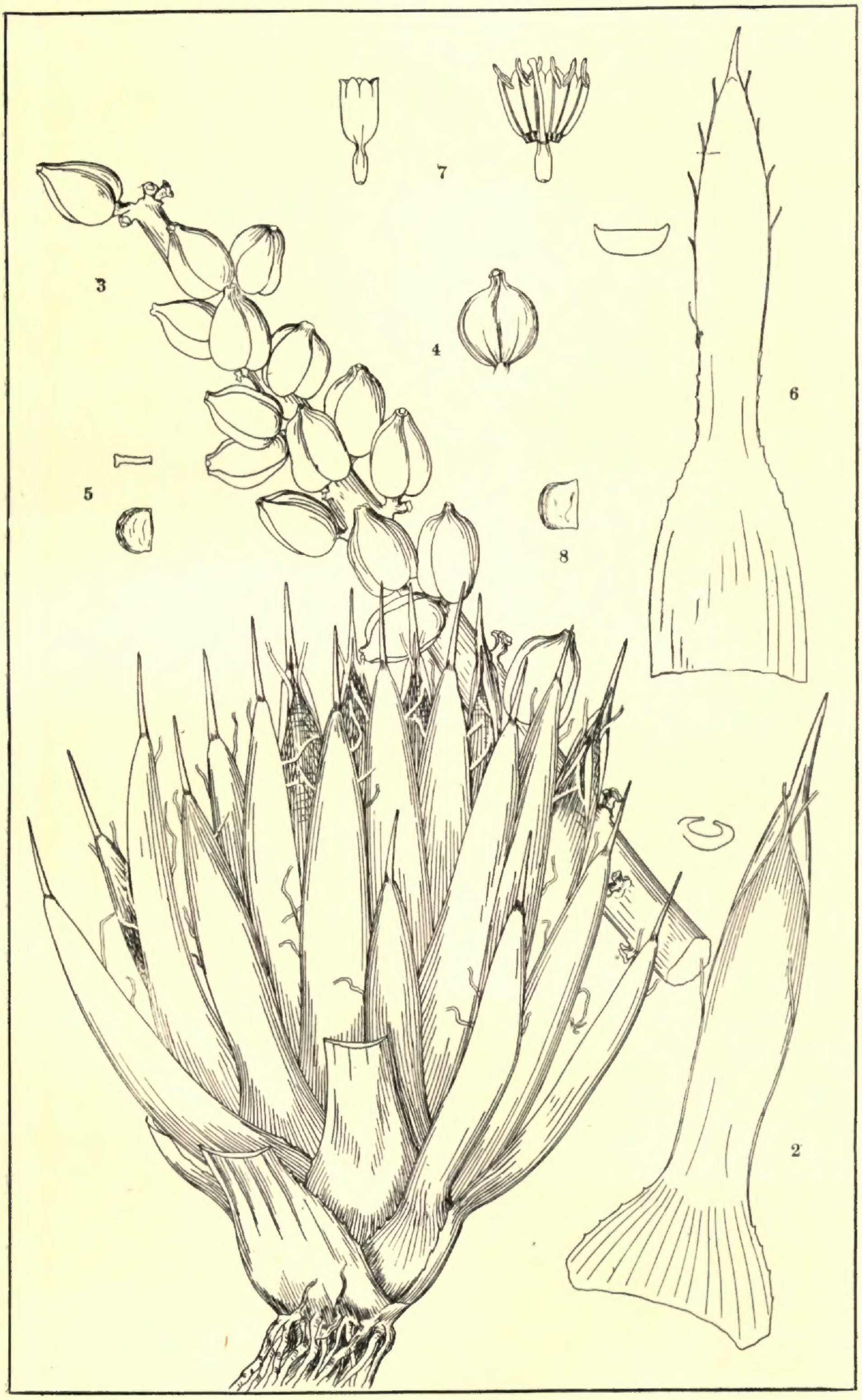
CRASSULA QUADRIFIDA.



COTYLEDON ORBICULATA.

DUDAIM AND PRESERVING MELONS.

TILLANDSIA UTRICULATA.



AGAVE PARVIFLORA.